INTERDISCIPLINARY ANALYSIS AND ASSESSMENT OF TRANSFERRING SCIENCE AND TECHNOLOGY ACHIEVEMENT TO FARMERS IN THE RED RIVER DELTA

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ZUSAMMENFASSUNG

Das Red River Delta (RRD) ist einer von zwei größten Flussmündungen in Vietnam. Das Gebiet ist der Ursprung des Reises in diesem Land. Die Landwirtschaft spielt eine entscheidende Rolle für die Wirtschaft Vietnams besonders im Red River Delta. In den vergangenen Jahren hat die Adoption von Neuerungen in der Landwirtschaft die Qualität und Menge der Produktion deutlich erhöht. Neue Getreidesorten wurden entwickelt, Management-, sowie Produktionsmethoden wie Integriertes Pest-Management (IPM) wurden verbessert, und Standards wie z. B. VIETGAP eingeführt.

Das Forschungsprojekt konzentriert sich auf die Frage, welche Möglichkeiten bestehen, den Prozess der Übernahme von Neuerungen durch Landwirte zu verbessern. Dabei sind die sozioökonomischen Bedingungen des Gebiets zu berücksichtigen. In dem Projekt wird das vorhandene Innovationssystem bewertet um daraus die Empfehlungen für Verbesserungen abzuleiten. Das interdisziplinäre Forschungsprojekt verwendet Ansätze der Diffusionstheorie, des kollektiven Handelns, und einzelne Erklärungsfaktoren (z. B. kulturelle Bedingungen) um das individuelle Übernahmeverhalten erklären zu können. Die empirischen Ergebnisse der Arbeit beruhen auf 15 Experteninterviews und 85 ausführlichen Befragungen von Kleinbauern.

Die Zusammenarbeit zwischen Bauern, Beratern, Servicedienstleistern, S&T Organisationen, landwirtschaftlichen Unternehmen und NGOs wird beschrieben. In vielen Fällen geschieht der Transfer an die Bauern, durch (1) von vertraglichen Vereinbarungen zwischen den Partnern, (2) durch Anreize, oder (3) durch Lernprozesss im Anschluss an die Verbreitung der Information durch Informationsnetze. Die Rolle von Bauern in diesen Prozessen ist sowohl durch eine aktive oder passive Teilnahme gekennzeichnet. Die Landwirte werden in Gruppen eingeteilt: frühe Adopter, Imitatoren (späte Adopter) und Nichtadopter, um das Adoptionsverhalten besser erklären zu können.

Schlüsselwörter: Innovation, Beratung, Diffusion, Wissenschaft Technologieentwicklung, Adoptionsforschung, Wissenstransfer

ABSTRACT

The Red River Delta (RRD) is one of two biggest deltas in Vietnam. The region is the origin of paddy rice in the country. Agriculture plays a crucial role for Vietnam's economy, especially in the RRD. Recently, adoption of innovations in agriculture has enhanced the quality and quantity of production. Old varieties of crops have been replaced, and improved management practices as well as production methods such as Integrated Pest Management (IPM), VIETGAP have been implemented.

This research project focuses on the question, whether there is a need to enhance the process of innovation transfer to farmers. Socioeconomic conditions of the region have to be taken into account. The project will evaluate the existing transfer system and tries to find out if it is possible to improve the innovation transfer by interfering into the process. The interdisciplinary research project uses the theory of diffusion of innovation, theory of collective action, and other explanations such as the cultural influence and individual behavior. The results of this report are based on 15 expert interviews and 85 detailed questionnaires of smallholder farmers.

The cooperation between farmers and agents of extension services, S&T organizations, agricultural enterprises, NGOs will be described. In some cases, the process of innovation transfer to farmers happens directly because of agreements in a contract between partners, or motivated by incentives, or simply pursuant to a learning process following diffusion of information through networks. The role of farmers in these processes is also directly observed as an active or passive participation. Farmers are classified in groups of adopters (potential adopters, early adopters), imitators (later adopters) and non-adopters and factors to explain the adoption behavior are discussed.

Keywords: transferring innovation, extension service, diffusion, science and technology's achievement, adoption research

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND EQUIVALENTS

AIS	Agricultural Innovation System
ATT	Adoptive Technology Transfer
"doi moi"	the policy has renovated the economy of Vietnamese for a better performance, has oriented the economy to the mechanism of market economy
FAO	Food and Agriculture Organization
FPR	Farmer Participatory Research
FSR	Farming System Research
IPM	Integrated Pest Management
NGOs	Non Government Organisations
NIS	National Innovation System
NPK	Fertiliser including N, P, K
QH	Vietnamese National Assembly
R&D	Research and Development
RRD	Red River Delta
S&T	Science and Technology
T&V	Training and Visiting
TOT	Transfer of Technology
TTg	Vietnamese Prime Minister
VAC	Garden, Fish Pond and Livestock
VIETGAP	Vietnamese Good Agricultural Practice
VND	Vietnam Dong (currency unit)

1. INTRODUCTION

1.1. Background and Context

Science and Technology (S&T) are a key factor in supporting the development of all modern and new emerging economies (WorldBank, 2007; Nguyen, 2006). In Vietnam's agriculture, the application of advancement of S&T has been a significant contribution to the growth of the agricultural gross output from 112,1 trillion VND in 2000 up to 169,5 trillion VND in 2010[1]

Located in the tropics with a very long coastal area, Vietnam has an advantaged geographical location and a favorable climate for the production of various agricultural products. Recently, Vietnam has adopted a new "doi moi"[2] policy, changing the controlled command economy to a market oriented economy. In this context, free-market regulation has become the dominant regulator of economic activities, contributing to the application of S&T's advancements in agricultural production. Since joining the WTO in 2006, Vietnam has gained access to a broader market for its agricultural products. With an expanded market accompanied by strict rules of goods' quality and quantities as well as serving time, there has been a strong demand for implementing innovation in production within the country. As argued by Humphrey and Memedovic (2006), the development of production is possible if producers from developing countries are able to fulfill the complex and changing requirements of buyers from developed countries.

In methodology, a recent approach, termed AIS[3] (Agricultural Innovation System) by the World Bank, has focused on implementing agricultural innovations (Box 1.1), in which they indicate the importance of linkage between the involved players. In the AIS framework, the factor of demand and initiatives in encouraging the participation of actors in innovation play an important role in enhancing development. In Vietnam, market forces have contributed to innovation in the agricultural sector. As well, the adoption of renovate policy has freed the creativeness of all economic entities in the economy, especially, in the two main delta regions[4], where economic growth has been strong in many sectors. Many

[1] Data is extracted from Statistical Yearbook of Vietnam 2011, at constant 1994's price, General Statistics Office, 2011. (in 1994, 1 USD = 10800 VND).

[2] The policies have renovated the economy of Vietnam. They have changed the economy from a command-controlled regime to a market-oriented economy.

[3] There are two critical books relating to this viewpoint, published by World Bank in 2007 and 2012, as cited in the reference of this study

[4] Red River Delta and Mekong River Delta

factors have contributed to the adoption of agricultural innovations, including governmental research and development (R&D) organisations, the state extension service[5], NGOs, business enterprises, local associations of farmers, and commercial retailers and transporters. The state extension service in particular has an official mission to transfer improved goods and services to farmers.

Box 1.1. Agricultural Innovation System (AIS) defined

"AIS describes the multiple conditions and relationships that promote innovation in agriculture. It may offer a more flexible means of dealing with the varied conditions and contexts in which innovation must occur. AIS approach considers the diverse actors involved, their potential interactions, the role of informal practices in promoting innovation, and the agricultural policy context" (WorldBank, 2012: p4)

The transfer of improved goods and services to farmers to enhance the development of agriculture in such favorable condition has become an interesting topic for research, attracting the interest of researchers, policy makers, farmers and others.

As farmers are the target-recipients of improved goods and services including advancement in S&T, their opinion and evaluation is extremely important for improving the effectiveness of the transfer of improvements and enhancing the development of agriculture in the country.

Through an interdisciplinary analysis, this study aims to determine how the achievements of S&T would be most effectively transferred to farmers facilitate economic development of Vietnam's rural regions.

1.2. Problem Statement

The Red River Delta (RRD) is one of two major deltas of Vietnam. Historically, paddy rice ariculture has formed the basis of production in this area. Recently, the application of S&T's achievements in agriculture has enhanced the quality and quantity of agricultural production, leading to replacement of old varieties of crops and animals' with new ones, which is fostering continued agricultural growth. Therefore, the process by which S&T achievements are transferred to farmers has become a focal point for research, especially with the advent of a free market economic structure in the Red River Delta region,

[5] This organization has been found in Vietnam since 1993, spreading from national level to local communal level.

including diversified ownership and diversified modes of production. Development has resulted in replacement of old varieties of crops such as rice, vegetable, fruit, and livestock with new ones such as CR 64, Bac Uu 51 (rice), Peking duck, F1 mixed breed pig, lean-oriented pig, butterfish, snapper fish, Philippine high-yield tilapia, and Anguilla fish. Besides, Integrated Pest Management (IPM) has also been implemented widely.

A number of players have been involved in executing the process of transferring S&T's achievements and applying them in reality. For instance, the National Maize Research Institute has co-operated closely with agricultural co-operatives in former Hatay province (Hanoi currently) to produce high-yield hybrid corn seed, high-quality corn seed, and sweet corn. Further to this, the Hanoi Agricultural University works with neighboring co-operatives to produce fruit varieties using new grafting and cultivation techniques. Additionally, a new combination of vegetable, fruit, aquaculture and livestock production also forms the basis of a new system known as the VAC (Garden, Fish Pond and Livestock) model. With its advantageous location amidst a high concentration of S&T research organisations, the Red River Delta is poised to adapt and benefit from S&T achievements' transfer.

Many types and channels of transferring improved goods and services to farmers have emerged:

- Transferring improved goods, services and relative advancement by contract: According to contractual agreement between partners, mostly farmers and agricultural enterprises, both sides apply S&T achievement for producing products at certain standards.
- Transferring improved goods, services and relative advancement through the operation of the state extension service: New techniques and knowledge are transferred to farmers by training, diffusion, supporting of extension services.
- Transferring improved goods, services and relative advancement by direct investment of state or international support: In this model, many projects are presented as samples for demonstration, adaptation and dissemination by farmers themselves.
- Transferring improved goods, services and relative advancement by other communication channels such as mass media, and word-of-mouth, that might

provide new knowledge and techniques to farmers. Farmers can observe, investigate and apply the improvements.

- In addition, learning from neighbors or relatives is very popular in Vietnam's rural areas, perhaps because farmers feel more comfortable adopting approaches already being employed by their peers. Initiatives to strengthen the self-learning process and self-innovation are important to this type of dissemination of new techniques.

Theoretically, summarising the historical process of transferring S&T achievement in agriculture, several models have emerged: Transfer of Technology (TOT), Adoptive Technology Transfer (ATT), Farming System Research (FSR) (Ellis, 1992). More recently, a new form has emerged from the practice called Farmer Participatory Research (FPR) (Daniel, 1992).

However, at a higher development level of the economy, these forms of transferring S&T's advancements to farmers seem to be ineffective due to a number of factors:

- The existence of a gap between capacity of R&D organizations in serving farmers' demand;
- Poor capacity of local authority in managing low-quality inputs
- Un-controllable pollution caused by the overuse of hazardous chemicals
- Breaking of contract between farmers and firms
- Ineffective operation of local extension services

Yet the demand from farmers for innovative advancement continues to increase as they seek to improve production methods in order to compete in the international market with producers from other countries. The opening of the international market presents both opportunities and challenges for domestic production. This situation should be seen as a window of opportunity for the application of S&T's advances to improve production.

This study addresses the necessity of enhancing agricultural production from the farmer's perspective. By soliciting opinions and evaluation from farmers, I will examine the process of transferring innovative advancements to farmers in the region and providing recommendations to improve this transfer. I focus on the Red River Delta in Vietnam. Proceeding from the assumption that farmers' require improved goods and services is the most influential factor driving the diffusion of innovation, I examine the processes by which innovation is transferred from theory to practice.

1.3. Research questions

This study addresses the necessity of enhancing agricultural production by enhancing the process of transferring S&T's achievement to farmers. Starting from farmers' perspective, a main question has emerged “How can the transfer of S&T achievements to farmers be improved”. To answer this question, I use an interdisciplinary analysis basing on the theory of diffusion of innovation, theory of collective action, and consideration of cultural factors and their influences on individual behavior. This study documents and analyses the activities of different actors involved in the transfer of S&T achievements, namely (1) farmers, as end-users of innovative advancement or innovators; (2) extension staffs and local authorized officers, as bridging intermediaries connecting creators and users, and (3) scientists from R&D institutes in Vietnam, as creators of innovations. In addition, I reflect on how creators and users could be more effectively linked on the local scale. Proceeding from the assumption that farmers' requirement is the most influential factor driving the diffusion of innovation, I will examine the processes by which S&T's achievement is transferred from theory to practice, including issues of:

- What are the implications of implementing S&T in agricultural production, and how are these implications perceived by farmers?
- Who are the actors responsible for transferring S&T achievements to farmers, and what are the linkages between the relevant actors?
- What factors constrain this process and how can we overcome these difficulties?
- How can we encourage the co-operation of actors involved in the process of transferring S&T achievements to farmers?
- How should S&T's achievements be transferred to farmers?

1.4. Statement of purpose and significance

This study takes a "farmer's eye view" to examine the process of transferring "innovative advancements" to farmers and encouraging them to apply these improvements in their production. The research aims:

- Literature review on transfer of S&T to farmers;
- Drawing a general picture of the process of transferring innovative advancements to farmers in the Red River Delta of Vietnam

- Deriving suggestions for implementing an agricultural innovation system in the region.

Also, this study does not concentrate very much on the recommendation available to invest in science and technology, which is well recognised in innovation systems theory. Rather, it focuses on the additional insights and types of interventions that can be derived from research on co-operation between farmers and other actors, including agents of extension services, S&T organisations, agricultural enterprises, NGOs, as well as farmers' neighbors. The process of transferring innovative advancements to farmers might be appear directly in the form of contractual agreement between partners; as the result of incentives to adopt new technology, or simply as a learning process under the effect of diffusion of information from the media, friends, and relatives. The role of farmers in these processes may comprise either active or passive participation. Farmers who use these innovations can be defined either as adopters (potential adopters, early adopters) or imitators (later adopters) (Rogers, 2003).

1.5. Organisational structure of this thesis

The thesis is organised into six chapters.

Chapter 1 provides a general introduction of the thesis

Chapter 2 outlines the role of science and technology in the development of agriculture in rural areas; the processes involved in transferring innovative advancements to farmers; and difficulties restraining the effectiveness of the transfer process.

Chapter 3 describes the methods and research design

Chapter 4 introduces the region of research, the Red River Delta

Chapter 5 presents empirical research on the process of transferring and applying innovations in agricultural production, in the Red River Delta.

Chapter 6 presents the conclusions and recommendations derived from the study.

2. PERCEPTIONS AND ARGUMENTS ON THE PROCESS OF TRANSFERRING SCIENCE AND TECHNOLOGY ACHIEVEMENTS TO FARMERS

Today, we can see that a rapid growth in all fields of the economy, including agriculture and rural areas is taking place. Science and technology plays an important role in development, either as a major source for the development of agriculture (WorldBank, 2012), or as criteria for measuring the level of development. Science and technology has fostered increases in yield, quality, and productivity for a wide range of products. In addition, it has been considered as a factor supporting sustainable development, because it would support for a formulation of a reasonable economic structure. Three major forms of these innovative applications are widely accepted including (1) Farmers learning by doing; (2) Formalized agricultural research and development, both publicly and privately funded; (3) Direct inter-country transfer (Jarrett, 1985).

In developing countries, harnessing science and technology for human purposes would change production towards modern systems and overcome emerging difficulties (Ahmed and Ruttan 1988). Thanks to recent rapid advances, science and technology has reshaped all fields of human socio-economy. The application of S&T's achievements in agriculture has positively influenced productivity of crops and livestock, as well as the productivity of labour, the rural environment and the effectiveness of investment. Many involved parties have benefited from the adoption of these advancements.

However, the application of such advancements is mainly concerned with short-term profit, without concerning to long-term effects, such as the sustainability of development and its environmental effects. This shortsighted perspective has caused serious damage to economy, society, and environment in rural areas. These problems should be recognised, understood and eliminated on the road to achieving a modern production system.

Recently, a new approach in all efforts to support for enhancing the application of S&T in agricultural production has been emerged. It does not only focus on the "what", but also on the "how" of the transferring process. This new approach, called Agricultural Innovation System (AIS), takes the National Innovation System (NIS) as its backbone (Box 2.1.)[6] for encouraging innovation in agriculture. In fact, the innovation system has been a focal area of innovative research for more than two decades (Lundvall, 1992; Freeman, 1995; Nelson,

[6] This trend is easily observed in the recent book "Agricultural Innovation Systems: an investment source book", published by World Bank, 2012. ISBN (electronic): 978-0-8213-8944-7, Washington, D.C.

1993; quoted by WorldBank, 2012). Now, in a new context, it emphasises the innovation system in agriculture and linkage between involved actors to enhance innovative activities (Box 2.1) resulting from consumers' demand.

Box 2.1. Changing of approach

In the 1980s, the “national agricultural research system” (NARS) concept focused development efforts on strengthening research supply by providing infrastructure, capacity, management, and policy support at the national level.

In the 1990s, the “agricultural knowledge and information system” (AKIS) concept recognized that research was not the only means of generating or gaining access to knowledge. The AKIS concept still focused on research supply but gave much more attention to links between research, education, and extension and to identifying farmers’ demand for new technologies.

More recently, attention has focused on the demand for research and technology and on the development of innovation systems, because strengthened research systems may increase the supply of new knowledge and technology, but they may not necessarily improve the capacity for innovation throughout the agricultural sector.

Source, WorldBank 2007. Enhancing agricultural innovation: How to go beyond the strengthening of research systems, Washington DC, eISBN: 0-8213-6740-4, pp. xiv

To explain the new approach, I compare the new "innovation system" approach with two previous methods. I also address the weaknesses in S&T transfer related to shortcomings of state research and development (R&D) institutes and state extension services, as well as the implications of increasingly intensive participation of private firms in the process. (Box 2.2.)

Box 2.2. Summarizing new trends in agriculture from the "innovation system" perspective

The approach of "innovation systems":

(1) draws attention to the totality of actors needed for innovation and growth,

(2) consolidates the role of the private sector and stresses the importance of interactions within a sector, and

(3) emphases dissemination of the fruits of technological breakthroughs rather than the strengthening of research systems and their outputs themselves.

Six changes in agricultural development heighten the need to examine how innovation occurs in

the agricultural sector:

1. Markets, not production, increasingly drive agricultural development.

2. The production, trade, and consumption environment for agriculture and agricultural products is growing more dynamic and evolving in unpredictable ways.

3. Knowledge, information, and technology are increasingly generated, diffused, and applied through the private sector.

4. Exponential growth in information and communications technology has transformed the ability to take advantage of knowledge developed in other places or for other purposes.

5. The knowledge structure of the agricultural sector in many countries is changing markedly.

6. Agricultural development increasingly takes place in a globalized setting.

Source. WorldBank 2007, Enhancing agricultural innovation: How to go beyond the strengthening of research systems, Washington DC, eISBN: 0-8213-6740-4, pp. xi, xiii

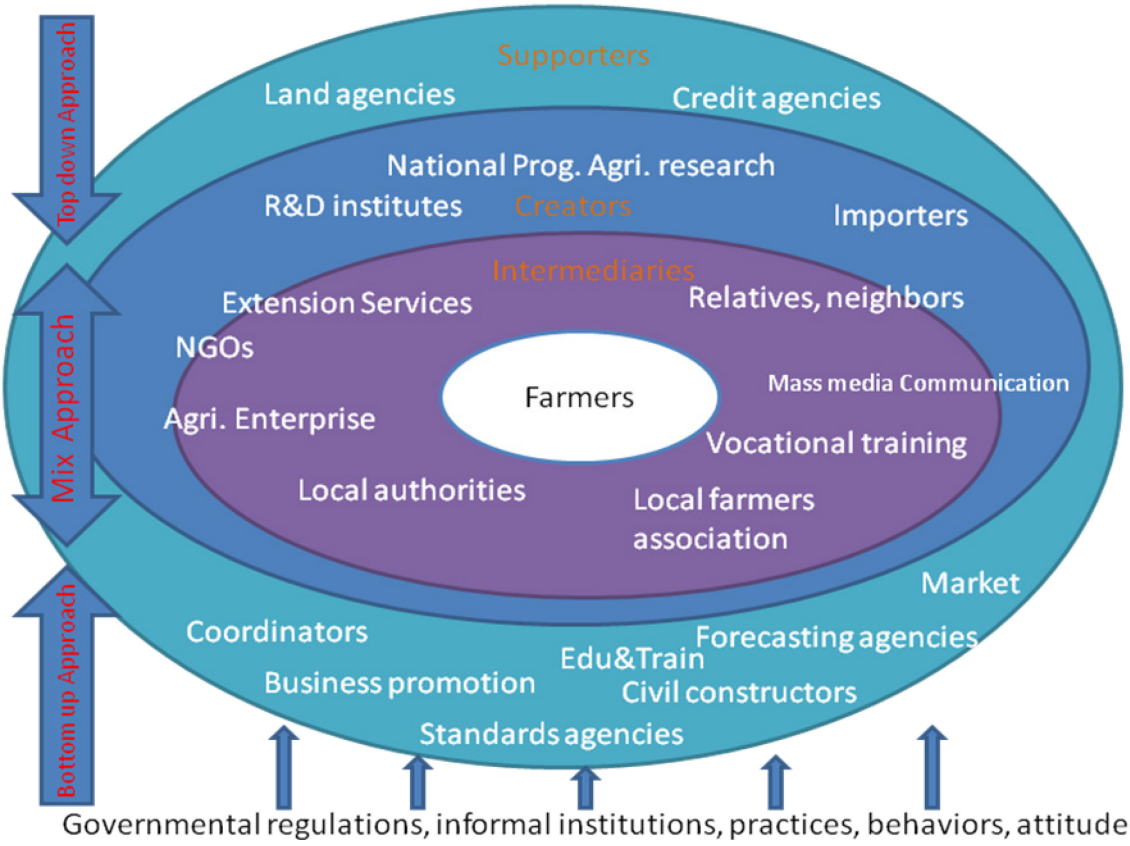


Figure 2.1: Transferring innovations to farmers: An overview of key actors and their linkages

Source. Modified from WorldBank 2012 (originally quoted from Rivera et al.).

Due to the importance of S&T advancements in the development of agriculture, finding an effective way to transfer S&T's advancements to farmers is also an important concern. To understand how to communicate more effectively with farmers in need of technological advances, research needs to consider the perspective of the farmers themselves. Once again, the statement of "taking farmers as the central subjects" in the chain of transferring improved goods and services from creators reflects the starting point of the approach in this study, where farmers' opinions and evaluation is very important for improving the effectiveness of the transfer's process. As described in figure 2.1, farmers are at the center, and surrounded by many other actors who might be intermediaries or creators of S&T advancements. Consideration of linkages and relationship among actors is essential for a smooth transfer of these advancements at every steps from the laboratories to the market. This chapter will examine what would be transferred to farmers, how the actors function, how the transfer occurs and finally, when and how the advancements have been applied in Vietnam.

2.1. Perceptions and arguments on "science and technology's achievement" and their application in agriculture and rural development

This part will clarify a research question "What are the transferable implication of S&T in agricultural production, their perceptions and related arguments?".

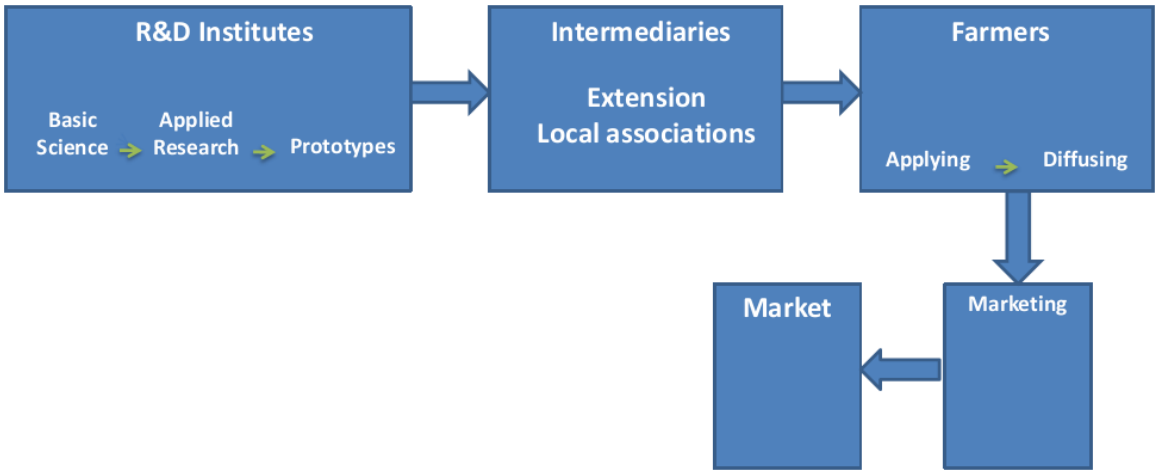
2.1.1. An overview about what would be transferred to farmers

Today, the implication of science and technology appears in all sectors of the economy and all fields of artificial production. In agriculture, S&T has been applied in many stages, periods and fields, in either focusing on technical or managerial issues. The application of S&T has brought efficiency; exploiting input resources as capital, labors, land, time, seed/breed, or improving productivity and product’s quality, as well as limiting the damage of natural disasters, and restraining the market’s risk. S&T also participates in each development stage of agriculture, in not only traditional areas but also extending to the peripheral frontier. The availability for improvements in chemical-biotechnology, informatics-biotechnology, informatics-mechanics and others, etc. has proven this. Following from this, the implications of S&T might be reflected in forms of improved visible things such as improved inputs, improved technical facilities for preparation, for production, for harvesting and processing, improve technology, or improved invisible things such as improved procedures for production, for crop protection, for diseases control

and so on. However, in reality the number of applicable S&T advancements does not fully reflect the success of the process of transferring such issues to farmers. Success has only occurred when these advancements have been accepted by farmers and then applied by them. The failure of sending modern and big machinery into the field for agricultural production in Vietnam in previous years (in 1960s) has proved this statement. Therefore, an acceptance of farmers should be taken into account when transferring improved goods or services to them.

Box 2.4. Linear models

In a new book recently, written and published by WorldBank (2007) it concerns about the linear models in relation with innovation systems models: In linear models, the generation of S&T advancement is mostly done by R&D institutes, thus, investment for R&D institute is understood as investment for development in the future with a strong belief of "if you want more economic development, you fund more for science"



Source: modified from WorldBank (2007)

In addition to the question of what would be transferred to farmers, the means by which innovation is transferred is also an interesting question for research. According to linear model that reflect the belief that "basic science leads to applied science, which causes innovation and wealth" (Arnold and Ben, 2001; quoted in WorldBank, 2007) has been indicated in previous years (Box 2.4). In the model, three forms of innovative applications have been concerned as (1) learning by doing; (2) formalized agricultural R&D, both publicly funded as state R&D institutions, and privately funded as firms in agricultural input industry ; (3) Direct inter-country transfer through operation of agricultural input's import or operation of international NGOs (Jarrett, 1985). Currently, when the gap in

knowledge between highly qualified research staffs and actively talented farmers is narrowed through the support of modern information communicative technology (ICT), farmers are more capable in creating and summarising the best experiment for their utilisation. The process of natural selection as an adaptation to local environment carried out by farmers is not important as it has been previously because the availability of modern S&T has increased (WorldBank, 2012). Further to this, farmers who are better educated have a greater understanding of S&T contexts and they can choose the best advancement, or adapt their farms based on the success of neighboring or their relatives' farms. In addition, they can develop a suitable application of advancement for their own. In the linear model of transferring S&T's achievement to farmers, support for creators and intermediaries might be emphasised. In later situation, initiatives are not only invested for R&D institutes, but also to enhance the understanding of customer side, to create a favorable environment for innovative operations, or to make the transfer to be transparent and fair (Mytelka and Smith, 2002; Lundvall and Johnson, 1994). Intermediaries in the later situation are not only responsible for transferring certain innovative things to farmers but also responsible for connecting and enhancing the linkage between farmers and other sources of innovative advancement. In addition, helping farmers to earn more profit and to occupy market chances might be a new responsibility of intermediaries as extension service.

Returning to the question of what would be transferred to farmers, referring to terminology, an answer is not easy to obtain, "due to the several variables involved and because the innovation can have different causes of origin" (Coccia, 2006:7). There would be technological products innovation, technological process innovation (as stated by OsloManual, 1997: page 24, paragraph 9); or knowledge, information and technology (WorldBank, 2007; WorldBank, 2012); or "a change during the thought process for doing something, or the useful application of new inventions or discoveries, or new stuffs" (McKeown, 2008). This ambiguity in the terms of classification of terminology makes it difficult to compare various studies, where even applying the same type with different names or the same name with different types has hindered the development of knowledge in these fields (Coccia, 2006:1). This argument will be discussed in the next section, which provides an overview of the classification of what would be transferred to farmers, based on the innovation intensity.

Box 2.5. Knowledge is generated through interactive process

Nonaka and Takeuchi propose that knowledge can be created through four interactive processes between tacit knowledge and codified knowledge. These four interactive processes are:

(a) socialization (tacit knowledge to tacit knowledge);

(b) externalization (tacit knowledge to codified knowledge);

(c) combination (codified knowledge to codified knowledge); and

(d) internalization (codified knowledge to tacit knowledge).

They argue that these four knowledge-generation models are ubiquitous at the individual, group, organization, and inter-organization levels.

Source. Chang and Chen (2004).

2.1.2. An overview of classification of what would be transferred to farmers

As stated in previous paragraphs, the ambiguity of definitions in what would be transferred to farmers causes confusion and makes it difficult for people to understand them, as well as classifying the demand from farmers. Therefore, "a classification will help us to arrange and structure our knowledge in a way that is more fruitful and transferable that is simple list of description" (Coccia, 2006: 1). However, this is not an easy process due to the influence of several variables and different types of origin. For instance, in some recent books (in 2007 to 2012), scholars of the World Bank state that improved information, knowledge and technology, would be transferred to farmers while McKeown (2008) states that these transferable things relate to "change during the thought process for doing something", "useful application of new inventions or discoveries or new stuffs". However, these definitions are focused on the innovative function of what would be transferred, and the intensity of innovation would be a scalar in classifying these definitions, as suggested by Coccia (2006).

Before examining the classification with the scalar of innovation intensity, we need an overview of collection of definitions on innovation, as the transferable items are highly related to innovation, in some perspective, they are exactly like certain innovations. Thus, what do people refer to when talking about innovation? (see Figure 2.2)

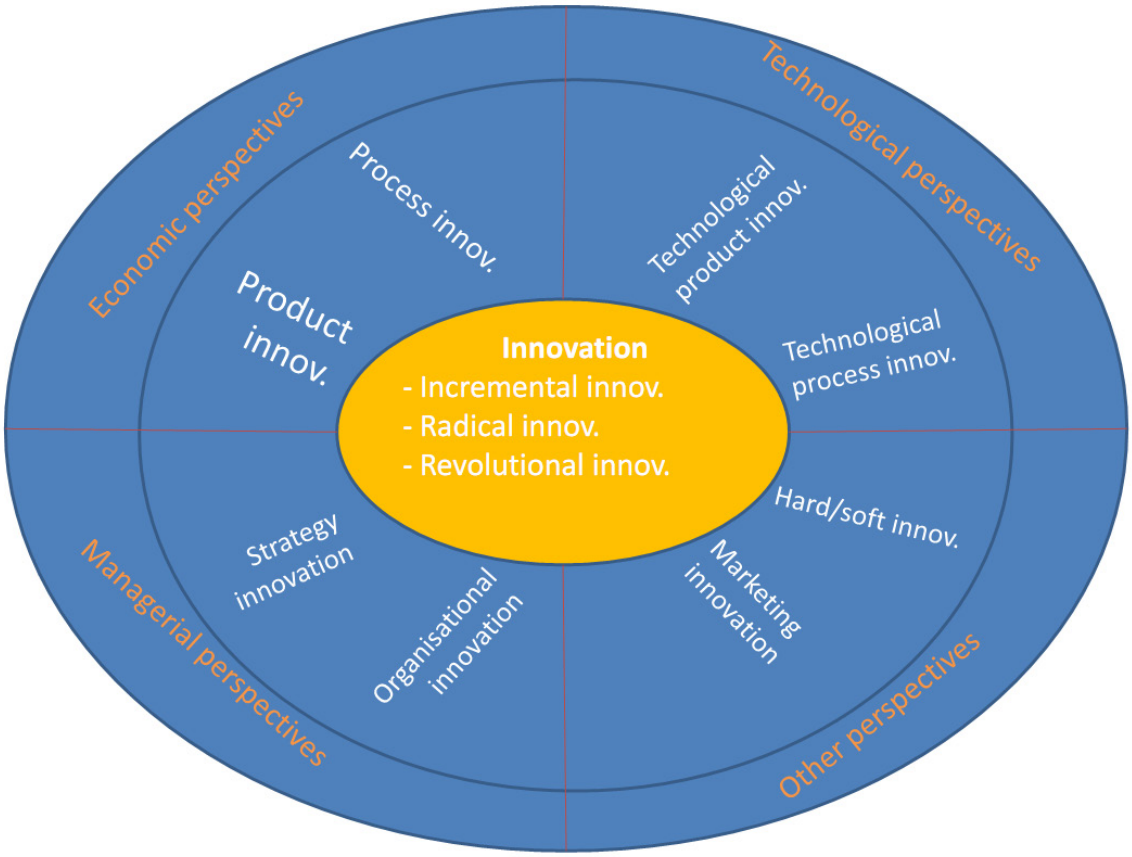


Figure 2.2: Clarification of innovations from different angles of view

Source. Own compilation.

Up to now, innovation has been discussed from the viewpoint of economics, philosophy, technological perspective, managerial perspective and in a broader context than just in traditional R&D. “Innovation is studied in many disciplines and has been defined from different perspectives” (Damanpour and Schneider, 2006: 216, quoted by Baregheh, 2009: 1324). Scholars have widened the application of “innovation” not only to products but also to things[7], i.e. “innovation applies not only to new business and product ideas, but also to the internal working environment of a company". Recently, the World Bank has also updated the definition about innovation as "the process by which individuals or organisations master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country, or the world" (World Bank, 2006, quoted in WorldBank, 2012). However, OsloManual (1997) (paragraph 24, page 9) has stated innovation is the introduction of new goods or new quality of goods; alternatively an introduction of new methods of production; or an

[7] “Claus Weyrich wrote in Electronic News” is quoted by Small Business Encyclopedia

opening of a new market and dominated by a new branch. OsloManual (1997) also states that it is a conquest of a new source of supply or raw materials or a coming out of a new combination/organisation of an industry; and a long list of definition about innovation.

Box 2.6. An very old definition of innovation

Schumpeter had argued in his two books: The Theory of Economic Development (1934) and Capitalism, Socialism and Democracy (1942), in which he describes two different patterns on industrial innovation: the Schumpeter Mark I in the former book and the Schumpeter Mark II in the later ones.

Starting by his first studies around the 1930s on how the capitalist system could be affected by market innovation, Schumpeter derived a term "creative destruction". The process of "creative destruction" is described in his book "Capitalism, Socialism and Democracy" as a process where "the opening up of new markets, foreign or domestic, and the organizational development... illustrate the same process of industrial mutation, that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one". He means "innovation" is a process, by which a new thing will come and may result in a restructuring process, and also looking for the new thing is survival of entrepreneurship. In most of his literature, attention is paid much on entrepreneurial activities as main drivers of innovation. He assumed that an innovation (or innovations) is existed in cases of:

- An introduction of new good or new quality of a good, or
- An introduction of new method of production, or - An opening of a new market and dominated by a new branch, or
- A conquest of a new source of supply or raw materials, or
- A coming out of a new combination/organization of an industry.

By this clarification, the definition of innovation by Schumpeter deals with some important issue of innovation such as: innovation is a process, the context by that innovation appears, the importance of understanding of innovation among competitors, innovation and its impact on the process of economic restructuring, and conceptual issues of organizational innovation.

Furthermore, he tried to develop a theory where a company's ability to innovate was mainly connected to its size. Initially, he stressed the better role of small and medium-size companies in conducting innovation due to their flexibility while large companies might get disadvantage in bureaucratic structures[8]. Later, he changed his idea by opposing the role of larger corporations in

[8] As understood as „the Schumpeter Mark I"

conducting innovation due to their strong power of abundant resources[9] . He built up "a framework economic growth with emphasis on autonomous investment embodying new technical innovation as the basis of economic development, whereas in the Keynesian framework the emphasis is on management of demand" (Freeman, 1982, p. 2). These studies on innovation are typically connected with technological and economic context of this definition. He started a Schumpeterian school where different strands of analysis of innovation in industries are developed: (1) analysis of the relationship between market structure variables, i.e. firm size, industry concentration, entry and the level of innovation activity; and (2) pattern of innovation over the life cycle of industries; and (3) technological regime condition. Schumpeter has indicated terms of innovation basing on the available of factor "time", that is incremental innovation, radical innovation. These terms are then developed by Schumpeterian's scholars.

- Incremental innovation: many small steps of minor improvement have been collected by times that are integrated in a final product. This type of innovation implies the collective actions of creators as well as creative work of them. Each new idea should base on old ideas and should originate from certain context. It doesn't rely on creating something from nothing. Then finally, the final product would be completely different in compare with the predecessors.
- Radical innovation: In comparison with incremental innovation, radical innovation contains big steps of changes that create major improvements as a breakthrough.
- Revolutionary innovation: This degree of newness implies a huge, far-reaching impact to current situation. It contains many separate innovations, even more than incremental innovation or radical innovation, e.g. Green Revolution contains of many innovations in new crops' varieties, etc. that have improved the productivity of crops and growth of agricultural economies. In reality, these innovations often rely on each other. Incremental steps lead to radical innovations that, taken together, lead to revolutions.

The authors imply a huge variation in meaning relating to technological goods/services, progressive processes, or a way of arrangement that contain innovative actions, or managerial methods to improve the performance of an organisation which are changing continuously or discontinuously. However, all the scholars agree the two main common meanings of innovation, which are: The change of something that contains newness and their usefulness for certain customers. In other more concrete situations, those concepts are also considered under certain context and background, for example, under different

[9] As understood as „the Schumpeter Mark II"

perspectives of technical viewpoint, or theoretical review, or progressive issues, or a change in thought, etc.

Later on, the development of the concept of "national innovation system" was made, this places "innovation" in a broader context containing other methodologies of research. The term "National Innovation System" has been pointed for this set of institutions and flows of knowledge that "emphasises on the interplays between institutions, looking at interactive processes both in the creation of knowledge and in its diffusion and application" (OsloManual, 1997:6). By that way, innovation is not only set in vertical linkages or horizontal linkages but also in a network of multi-related linkages.

From the technological perspective

In 1997, the OsloManual, 2nd Edition, proposed by OECD, focused on two first Schumpeter categories[10], in order to define the definition of innovation including technological product innovation and technological process innovation. These two first categories of innovation relate to technical issues rather than organisational innovation whose elements include new or improved organisational structures, management techniques or strategies. Two definitions were provided in the Manual, paragraph 24, page 9:

- "A technological product innovation is the implementation/commercialisation of a product with improved performance characteristics such as to deliver objectively new or improved services to the consumer".
- "A technological process innovation is the implementation/adoption of new or significantly improved production or delivery methods. It may involve changes in equipment, human resources, working methods or a combination of these".

Products here refer to both goods and services. Either new or improved products whose characteristics differ significantly from previous ones due to the use of new technologies/materials are technological product innovation. Meanwhile, a technological process innovation is defined by the adoption of new or improved production methods, including method of product delivery.

The Oslo manual also suggests that purely creative and aesthetic improvement should not be considered as innovation since the characteristics of commercialisation is not attached.

[10] As listed in the 5 types of innovations

"Innovation is a process that follows invention, being separated from invention in time. Invention is the creative act, while innovation is the first or early employment of an idea by one organization or a set of organizations with similar goals" (Becker and Whisler, 1967:463; quoted by Baregheh, 2009:1329).

From the managerial perspectives

When referring to the role of innovation in economy or in sustainable development of an organisation, innovation is considered as "the basic driving force behind entrepreneurship and the creation of small business" (Small Business Encyclopedia). Baregheh (2009) have quoted from Zahra and Covin, 1994:183: "Innovation is widely considered as the life blood of corporate survival and growth", or "Innovation represents the core renewal process in any organisation. Unless it changes what it offers the world and the way in which it creates and delivers those offerings it risks its survival and growth prospects" (Bessant et al., 2005:1366 quoted by Baregheh, 2009). It is assumed that innovation leading to increased productivity is the fundamental source of increasing wealth in an economy or: "Innovation is tightly coupled to change, as organisations use innovation as a tool in order to influence an environment or due to their changing environments (internal and external)".

Alternatively, West and Anderson (1996) (quoted by Baregheh, 2009) stated "Innovation can be defined as the effective application of processes and products new in the organisation and designed to benefit it and its stakeholders". Innovation literature while rich in typologies and descriptions of innovation dynamics is mostly technology focused. Most research on innovation has been devoted to the process (technological) of innovation, or has otherwise taken a how to (innovate) approach (Arthur, 1988; McKelvey, 1993).

The context where innovations become important for entrepreneurship is based on the need of generating a stream of new products, systems, technologies, and services in order to create and sustain a source of competitive advantage. In some specific cases, "Innovation is the change of thinking to escape from stagnant situation and looking for a new development". However, this opinion does not mean: "deep depression induces innovation" (Freeman, 1982:4), but in contrary, following to Freeman (1982), in many cases that "depression held back or limited the work". Depression is not mentioned as an accelerator, "but rather war time demand and/or government pressure and policies" (Freeman, 1982:4).

In other side, Sreenivas (2009) wrote in The Business Journal: “According to Weyrich, sustaining innovation in a business organisation requires an understanding of the company's core competencies, an innovative corporate culture, and a systematic approach”. Therefore, a culture of innovation needs to be encouraged within a company: "If all the people able to extract value from a new product or technology are in the information loop, there is a smaller chance that opportunities will be squandered. Making use of the information resources available within a company allows employees to benefit from corporate memory. They are better able to focus on innovation because they know where others have been before them” (Ken’s statement, quoted by Sreenivas (2009)). In that way, the process of innovation includes three main phases (Wayrich, quoted by Sreenivas, 2009): "(1) the invention phase, in which ideas are generated; (2) the implementation phase, in which the best ideas are selected and developed further; and (3) the market penetration phase, in which ideas are exploited for commercial gain”.

Thus, these scholars define innovation from a different perspective which embraces different forms of innovation, including three types of innovation: innovation as a process, innovation as a discrete item including products, programs or services; and innovation as an attribute of organisations. By that clarification, definitions of innovation would be derived differently. Their characteristics, their performance as well as their policy-impact could be different. However, two main things will not changed: the newness of changes and its usefulness for certain customers.

From the other perspectives

The definition of innovation when considered by other perspectives is different. In the Marketing Dictionary: innovation defined more critically as: “Product, service, or idea that is perceived by consumers as new”. This definition focuses much more on the side of the customers rather than that of the (Meyers and Devebec, 1992). Even, OsloManual (1997) has defined innovation into other types by which different definitions of innovation are derived respectively: product innovation; process innovation; marketing innovation and organisational innovation.

- Product Innovation: This involves a good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other

functional characteristics. In the education sector, a product innovation can be a new or significantly improved curriculum, and new educational software.

- Process Innovation: Process innovation involves a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software. In education, this can for example, be a new or significantly improved pedagogy.
- Marketing Innovation: Marketing innovation involves a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. In education, this can for example, be a new way of pricing the education service or a new admission strategy.
- Organisational Innovation: Organisational innovation involves introducing a new organisational method in the firm's business practices, workplace organization or external relations. In education, this can for example, be a new way organisation of work between teachers, or organisational changes in the administrative area.

Regarding above definitions, we could see the general agreement on "the change of something that contains newness", and its applicability for certain customers that implies the recognition of customers and newness originality of the innovation. For the first one, the change of something that contains newness, people usually ask the question: "How new is new". This question reveals that customers always have their own measurement on the newness of an innovation. In other words, customers judge the newness of innovations. Newness emerges when customers compare with other products or procedures or arrangements, normally these products/procedures/arrangements are in previous stages. Therefore, newness contains time spans. Today a product/procedure/arrangement is new when you compare with its predecessors, but tomorrow it will become old in compare with the new ones. Economists tend to focus on the process itself, from the origination of an idea to its transformation into something useful, to its implementation; and on the system within which the process of innovation unfolds. Since innovation is also considered a major driver of the economy, especially when it leads to new-product categories or increasing productivity, the factors that lead to innovation are also considered critically.

Effort of summarizing these abundant definitions and deriving a classification

Recently, efforts in generating of a collection of "a representative pool of definitions of innovation, from the different disciplinary literature of economics, innovation and

entrepreneurship, business and management, and technology, science and engineering" (Baregheh, 2009) have been observed. These efforts aimed at the requirements for clarification of defining innovation "beyond just the typical extremes of incremental and radical innovation" (proposed by Kahn et al., 2003:197 and quoted by Baregheh, 2009:1325). In spite of the fact that innovation is defined under different point of view, i.e. economics, business and management, technology science and engineering and others will lead to different definitions, Baregheh (2009). tried to formulate a common understanding and agreement on innovation in all types. They have focused much on innovation within business organizations and environments. The assumption of "one common clarified definition of innovation will not only provide a better understanding of the notion of innovation for the diverse range of practitioners within organisations, but will also enable researchers to collaborate more closely to more holistically investigate this complex concept.", Baregheh (2009) has also collected 60 definitions of innovation in order to identify a multi-disciplinary definition of innovation. However, the context where the definition of innovation originated from is not analysed clearly in their works. Moreover, these efforts have also a limitation when they do not consider the perspective where definition of innovation would be derived from. For instance, when people consider innovation as an activity, they may accept the definition proposed by WorldBank (2007), but when people consider innovation is an improved product or services, they might refer to the definition proposed by OsloManual (1997).

As well as Baregheh, Coccia (2005, 2006) tries to collect definitions of innovation in a classification, taking the background where the innovation is emerging, and the innovation intensity as a scalar. Coccia (2005, 2006) uses the approach called seismic as he measures and quantify innovation through an evaluation scale similar to that used in seismology by Mercalli. Starting from economics perspective, some of taxonomies for innovations presented in economic literature are synthesised in innovation degrees. As such, measuring the intensity of innovation might help to classify innovations into different 7 groups, in 7 levels of intensity: lightest, mild, moderate, intermediate, strong, very strong and revolutionary. The definitions of innovation are also re-arranged using key words. The intensity of innovation at the highest level, according to Coccia, will have highest impact on economy; and also is the target at which people are trying to reach.

In summary of this small part, innovation is becoming an important factor for economic development. Innovation maybe seen in many forms, from technical characteristics of an

improved good, service, or to be part of a whole process. Some innovations could be transferred to farmers such as improved seed, breed, techniques and management but some can only be supported by incentives such as building an innovative environment for innovation, enhancing the linkage with innovative forces. Innovation is different in comparing to invention because innovation contains operations after transferring, to continue the process of applying and diffusing, and invention relates very much to technological perspective while innovation could be seen in many other perspective. These conclusions are very important in defining the similarity of innovation in agriculture in empirical research.

2.1.3. Differentiation between innovation and invention

Understanding the differentiation between innovation and invention may change the thinking about how S&T's achievements should be transferred to farmers. Therefore, the process of transferring S&T's achievements to farmers is the process of transferring inventions or the process of enhancing innovation at locality?

First of all, invention is understood as the creation or discovery or production or finding out of something new or improved process or machine that is both useful and not obvious existed. "Invention culminates in the supply (creation) of knowledge, but innovation encompasses the factors affecting demand for and use of knowledge in novel and useful ways" (WorldBank, 2007:15). An improvement on an existing form or embodiment, composition or processes might be an invention. Invention is normally generated by R&D, but currently, with the development of education for all society, R&D is not the only means of generating or gaining access to knowledge (WorldBank, 2007; Meyers and Devebec, 1992). While both invention and innovation have meanings of implication, innovation needs to carry further operation relating to diffusion and getting profit as well as occupying market. Invention relates very much to technical work of highly specified staff while innovation relates to people with a wide spectrum of skills. Innovators produce market and profit from their innovations. However, contrary to this, inventors may or may not profit from their work. Invention presents for knowledge and innovation presents for the operation of transform such knowledge into entrepreneurial goods and services (Mytelka and Smith, 2002; quoted by WorldBank, 2007:15).Given the differentiation between invention and innovation, the transfer of S&T's achievement to farmers does not only include transfer of inventions but also contains other operations such as enhancing the

innovative activity of farmers, creating favorable for cooperation between actors and exploring chances for farmer to earn profit and to occupy market.

Box 2.7. The differentiation of innovation in compare with invention

WorldBank, 2007 has defined the typical differentiation of innovation in compare with invention:

- Innovations are new creations of social and economic significance. They may be brand new, but they are more often new combinations of existing elements. In contrary, inventions are mostly brand-new technological significance.
- Innovation can comprise radical improvements but usually consists of many small improvements and after that containing continuous process of upgrading. In contrary, invention is a radical improvement provided by qualified R&D.
- These improvements may be of a technical, managerial, institutional (that is, the way things are routinely done), or policy nature.
- Very often innovations involve a combination of technical, institutional, and other sorts of changes.
- • Innovation can be triggered in many ways. Bottlenecks in production within a firm, changes in available technology, competitive conditions, international trade rules, domestic regulations, or environmental health concerns may all trigger innovation processes.

2.1.4. Fundamental needs of innovative advancement as applying to production

Normally, when talking about the application of new technologies in agriculture, people are basing on their economic perspective to refer to innovative products, which have impacted on organisms or their habitat, in appropriate with farmers' want and need, given their explicit enthusiasms, alternatives, cultural inclinations, experience, livelihood strategies and superior insight into local conditions and constraints (Hounkonnou et al., 2006; Morss, 1976; WTO, 1995). As discussed in previously, these innovative advancements include improved product innovation, improved process innovation. In details, these improvement are achievements such as improved varieties, new improved chemical products, new improved bio-technologies, new machines, new improved crop rotation, new application of ICT, and a long list of new improved technologies. Moreover, the development of economics recently has led to the appearance of some new improved managerial methods. Farmers need to be not only taught how to utilise technical issues, but they also need to learn how to manage their farm in a better way. Regarding this

knowledge, some typical techniques are marketing, risk aversion in farm management, technique to record their work process, or techniques to manage the flow of farming investment should be transferred to farmers too.

The number of innovative products and innovative processes which can be applied in practice is becoming forever grown following the development of S&T and the grown of the economy. However, the result from the process of transferring such improvements to farmers is not similar for all. Some of innovative advancements are successful, but the others fail. There are many reasons, but mostly, characteristics of innovative advancement may reflect its success in transfer. The experimental lessons collected by many scholars in diverse knowledge bases have confirmed that the transfer of innovations to farmers is only successful when certain conditions are met, and innovative advancements should contain suitable characteristics (Murphy et al., 2012). For a successful transfer, the innovation should consider the farmers first, then they must also be useable for farmers. These characteristics of applicable innovations are counted as observability, visibility, communicability, profitability, trial-ability, reliability, flexibility, compatibility, complexity and relative advantages. (Redmond, 2004; Rogers, 2003; WorldBank, 2007; Fagerberg and Srholec, 2008; Patel and Pavitt, 1994)

- Observability, not like a definition in mathematics, is a characteristic of innovation in transferring process to farmers. Observability makes the innovation observable that farmers can see, can adapt or learn.
- Visibility, like observability, makes it easier for farmers to track how the process happens.
- “Trial-ability is the degree to which an innovation may be experimented with on a limited basis". (Rogers, 2003:16)
- Communicability of an innovation is “the degree to which aspects of an innovation may be conveyed to others”. (Rothman, 1974: 441, cited by Cannarella and Piccioni, 2011)
- Profitability: the ability to make a profit
- Reliability: the ability of a system or component to perform its required functions under stated conditions for a specified time period.
- Flexibility: the ability of an innovation to change, to apply or to be localised

- Compatibility: the ability of an innovation is perceived as being consistent with existing values, past experiences, and need of receivers
- Complexity: the difficulty of an innovation to understand and to use
- Relative advantages: the advantages of a innovation in comparison to its predecessor.

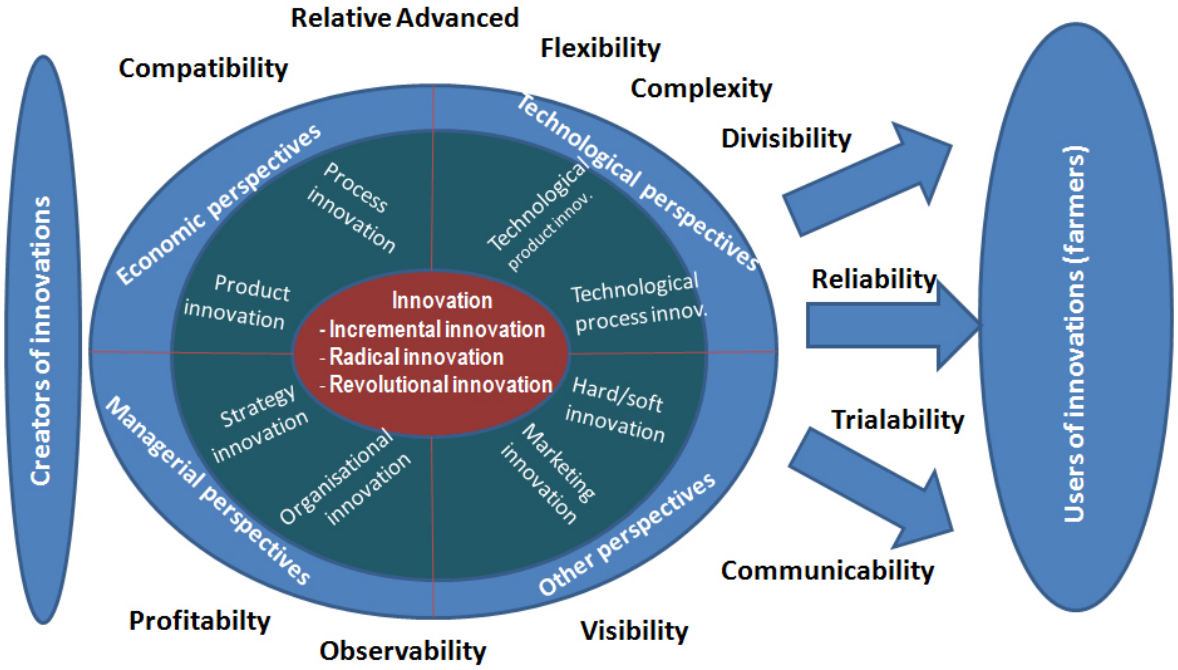


Figure 2.3: Synthesising the classification of innovations

Source. Own compilation.

The above ten characteristics work as indigenous conditions that need to be paid much attention when transferring S&T's achievement to farmers (Figure 2.3). However, the process does not depend on indigenous condition, it requires some other condition as exogenous conditions.

- The direct beneficiaries of the process of transfer are farmers. In developing countries, the farmers' characteristics are skeptical, they distrust outsiders; conservative, reluctant to innovation; selfish, autarky; psychology of crowd and a low-capability in approaching innovations have restricted the efficiency of the process (Shaw, 1987). These restrictions in addition to their financial limitation bring them an arbitrary in obeying the standards of the implementation process.

Therefore, it is necessary to issue incentives attracting the participation of support technologies, and enhancing the operation of extension services at locality.

- The transfer is not only to be conducted by intermediaries as extension services, but also can be carried out by many other organisations or individuals as universities, research institutes, NGOs institutions, overseas research institutions, and farmers themselves through direct link with farmers. In this situation, incentives are required to support farmers willingness to apply innovative advancement. The availability for such incentives would create a favorable environment for applying innovative advancement in agricultural production.
- Forms of transferring are also important, especially in the condition of the farmers' awareness is low. As concluded by many studies in the fields of extension service, the most effective way to transfer innovative S&T's achievement to farmers is attracting the involvement of farmers in the implementation, in parallel with incentives to keep the application alive within the community. Choosing a favorable form for transferring innovations to farmers is an issue that needs to be considered seriously.
- Other conditions regarding infrastructure in rural areas, i.e transportation, irrigation, communications, education and vocational training factors supporting the process.

2.2. The process of transferring S&T's achievement to farmers

This part will clarify a research questions:

- How do people expect from the application of innovative advancement in agriculture?
- Who are the actors responsible for transferring S&T achievements to farmers, and what are the linkages between the relevant actors?
- How should S&T's achievements be transferred to farmers?
- Also part of these two questions:
- How can we encourage the cooperation of actors involving in the process of transferring S&T achievements to farmers?
- What factors constrain this process and how can we overcome these difficulties?

2.2.1. The necessity of applying innovative advancement in agriculture

Along with the development of other sectors within the economy, agriculture has also been modernised with the application of modern machinery, improved seed/breed as well as improved managerial techniques, new procedures, and a long list of improved things/processes to ensure a safe production. The modernisation of agriculture on one hand equips farmers' with new modern skills, increases their knowledge in order to improve the farms production in terms of highly improved productivity, yield, quality, and safety of products, serving for the increasing demands of humans, but on the other hands, it requires the active participation of farmers to innovate. The application of innovative advancements of farmers may happen in a wide spectrum of operations, from investment for agricultural inputs, equipment/tools for production, managerial technology, harvesting and processing and others to satisfy the demands below:

2.2.1.1. Increasing demand for more highly qualified product

The United Nations has forecasted that the world population will increase to 9 billion people by 2050 (WorldBank, 2012), over 1 billion people of these will live in poverty, this has created a huge gap between demand and supply of food for life. Besides food for people, agriculture also provides materials for industrial sectors as well as food for livestock and aquaculture. Agriculture should be developed to serve for these increasing demand. Moreover, due to increases in the living standards, the structure of people's demand is changing, whereby more highly qualified products are required. Therefore the requirement for agricultural products is either quantity or quality, which is only satisfied by applying science and technology in production. With these increasing pressures, the traditional system of farming has come to need transformation, with the combination of traditional practices with formal agricultural science and technology.

2.2.1.2. Demand of farmers for diverse products

Demand from people for new products (i.e. demand for special goods, off-seasonal products, products for spiritual activities) is increasing and requires the creation of improved varieties, or the application of technical methods in processing. As suppliers for this demand, farmers are looking to science and technology for support to help produce off-seasonal as fruits, vegetables, or to propagate their special varieties/breeds or to apply new techniques in processing their products for a higher value, or to limit natural damage after harvesting. This is a chance for science and technology to be used in practice.

2.2.1.3. Demand for maintaining quality and reducing loss after harvesting

Lost values after harvesting occurs across the agricultural sector. The rate of loss is not the same for all products, regions or seasons, i.e. the loss of paddy rice is 12-16% during the summer season, and 8-12% in the winter season, or lose may reach to 100% for vegetables[11]. Therefore, technologies for processing and post harvest play an important role to reduce loss. These technologies are not only reducing the loss, but also could create new products for consumption, i.e. litchi canned, pineapple canned, infant cucumber canned, infant maize canned, and so on. Improvements in technological equipment are not the only things that can help to reduce the loss, this can also be done through improvements in management, or the development of linking buyers and producers, as well as the development of infrastructure can also positive influence to reduce the loss.

Beside fresh products, processed products have now become popular on the market. In comparison with fresh products, they have a number of advantages such as: (1) maintaining the quality of products or reducing the loss; (2) safety for consumption and might become favorable food with support of additives; (3) increasing the preservation time, as well as prevent rapid falls in prices at certain times of the year; and (4) diversifying the structure of food. In addition, the development of processing and post harvesting technologies could support farmers and prevent a price drop during harvest periods, for example (1) creating a demand for collecting products of farmers; (2) enhancing the cooperation between farmers and enterprises; (3) promoting the effort to form a trademark for agricultural products; and (4) orienting the consumer's habit by the presence of newly developed products.

2.2.1.4. Development of an agriculture towards commodity production

Agricultural development towards commodity production is an inevitable trend. Commodity production equipped with certain indicators of productivity, quality and competitiveness requires the application of appropriate technologies. Moreover, the use of these technologies may generate new products satisfying the demand of consumption. With existing strengths along with an appropriate development strategy, the agricultural sector is making a worthy contribution to the economic achievements of the country. Agriculture produces just not only for itself, but also stable materials for the processing industry and for export.

[11] http://www.thanhnien.com.vn/news/pages/200948/20091127235328.aspx

To develop agriculture in a sustainable way, it takes many measures, such as zoning specialised areas for growing major crops and applying scientific and technical advances in production. In addition developing the processing industry to increase competitiveness of agricultural products is required. Further to this, attracting domestic and foreign investment, promoting technological application and transfer in production is needed to make new breakthroughs.

2.2.1.5. Needs for safe products

A need for safe products from a clean production, taking health of consumers into account is becoming an important issue especially for agricultural production in emerging economies, whose monitoring and control are not fully adopted as expectation. The overload of chemical fertilizers or pesticides in agricultural production, or pollution from waste of industrial zones or handicraft villages, or heavy pollution in livestock farm, is causing environmental issues, leading to degradation in natural resources, or chemical residues which directly affect the health of consumers, killing good natural enemies. All of these problems have been recognised, and it is expected that they will be eliminated from production with the support of applying innovations to production. i.e. using IPM for a better disease controlling as well as chemical residual monitoring, or applying VietGAP with the expecting of producing safety products.

2.2.1.6. Exploiting natural resources for sustainable development

The more developments in production are made, the more natural resources is exploited quickly. This development is intrinsically unstable for the economic models where natural resource is considered as a non-replaceable input. Due to the limitation of natural resources, there needs to be a plan for effectively exploiting in the long run, to avoid exhaustion of these resources, and to minimise the negative impacts on future. Furthermore, it is necessary to use renewable resources replacing for non-renewable resources if possible. Therefore, applying appropriate technologies for specific regions, in combination with active support from users and researchers, taking properly personal interest and community-will into account, is the best policy to guarantee the sustainable development in the long term.

2.2.1.7. International competitiveness

Nowadays, most of the economies are no longer limited by national borders, they increasingly accede to the global economy. International competition has increased the

pressure on each member economy to produce products with high competitiveness, especially for export to advanced economies. Therefore, new technologies in terms of production's techniques, or managerial skills, or monitoring for high standardisation, should be applied. In addition, other innovations regarding informatics, communications, marketing, international laws, lobbying techniques, are used to get competitive information, maintaining the competitiveness as well as guaranteeing the fair trade for third world countries, need to be considered adequately. The application of new technologies might provide a chance for co-operation among countries, or connecting domestic market and international markets (Porter, 1980).

2.2.1.8. Minimizing the negative impact from price fluctuation of raw products in the international market.

In the product's structure of export from third world countries, raw products take up a large proportion. Therefore, the price's fluctuation of raw products in the international market always has a serious impact to their domestic production, and makes the economy highly vulnerable. Applying technologies, especially processing technologies may help them to avoid the bad impact from outside and consolidate their domestic production. In addition, other supporting technologies may be helpful including informatics, communications.

Due to developments in S&T, agriculture is being pushed towards commodity production seems to be appropriate, where the need for new technologies is indisputable. In addition to the transfer of innovations to farmers, which cover all fields of production from technical issues to non-technical issues, other supported technologies should be taken into account in order to generate a favorable environment for development.

These above primitive demands for the application of innovation and basic dynamics for farmers to innovate might not fully cover all related issues, but should form the basic reasons for the application of innovation and premise for the following analysis.

2.2.2. Transferring S&T's achievement to farmers

Given the importance of applying achievement of S&T in agricultural production as mentioned in above paragraphs, although the list is not completed, the transfer of innovative advancement to farmers is considered as necessary (Gal et al., 2011). However, "getting a new idea adopted, even when it has obvious advantages, is difficult" (Rogers, 2003). This means that although people recognise the advantages of innovation, it requires a lot of effort for introducing, persuading, transferring and disseminating (Figure 2.4).

2.2.2.1. Definitions

In general, trying to implement an innovative thing could be understood as a process of creating a new order of things under certain conditions and certain situations (Redmond, 2004).

This part considers not only innovative transferred advancements as the end-of-pipe outcome of R&D, but also as starting source of a technological change in farmers' households that impacts on productivity, sustainability and poverty reduction. This means, the process of transferring S&T's achievement will be lengthened from creator-intermediaries-users-market-dissemination (Röling, 2010). The new order may be understood as a linear process or multi-directions process, involves steps of transferring, objects of the transfer, actors in the transfer, channels for linking actors, proposed initiatives and constraints such as time constraints, and social aspects surrounding innovation. Three main groups of actors are concerned in the process of transfer, including group of creators, group of adopters (recipients) and group of intermediate organisations/individuals who are responsible for enhancing the rate of diffusion. New ideas or innovative thing would be transferred to the adopters from the creators directly or indirectly through intermediate organisations.

From the beginning, changes in the willingness of farmers to adopt innovation are considered as an important social phenomenon affecting the course of diffusion processes. Willingness to adopt has traditionally been regarded in adoption/diffusion theory as a function of the properties of the innovation (Redmond, 2004).

Thus, the transfer of S&T's achievement in this situation is similar to the process of diffusion of innovations. Diffusion of innovations here is not simply a process of autonomous behaviors (Munch and Smelser, 1987; Redmond, 2004). The actions of one individual can and do change the actions of others, whether in the case of cohesion model or the structural equivalence model.

Starting from the position of applicants as farmers, in general, they first have to make a decision regarding the adoption of an innovative advancement (e.g. a new high yield crop). Then the next step is to collect information on this innovation. This information then leads to the formation of perceptions about the innovation. In line with these perceptions, a decision to adopt or reject the innovation is made (Rogers, 2003).

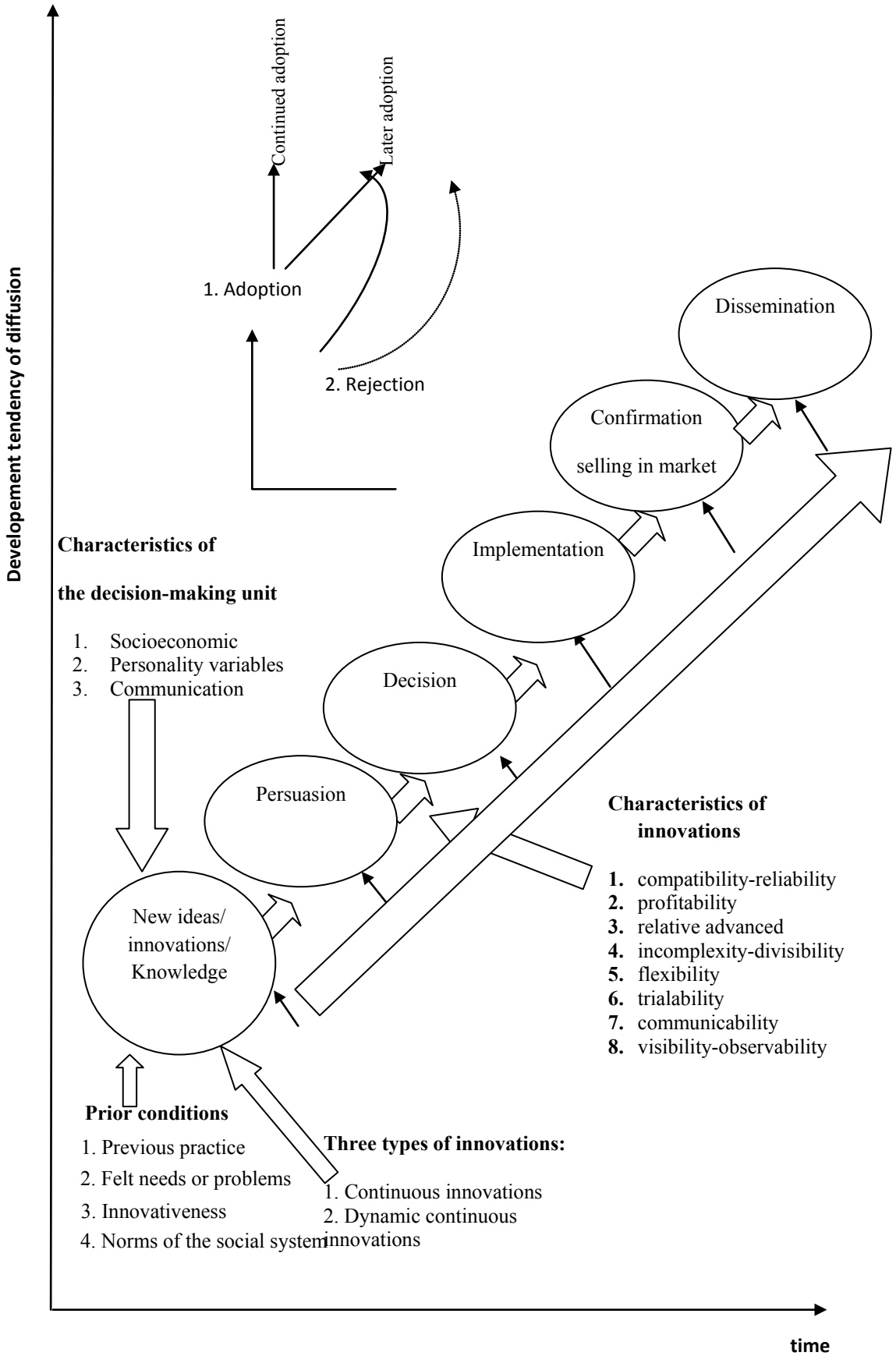


Figure 2.4: Overview of the process of decision making on diffusion of innovations

Sources: Modified from Rogers, 2003:170.

If the decision to adopt the innovations is taken, farmers should know where they can get the innovation, which channel they can approach, and lots of other kinds of information (Rogers, 2003).

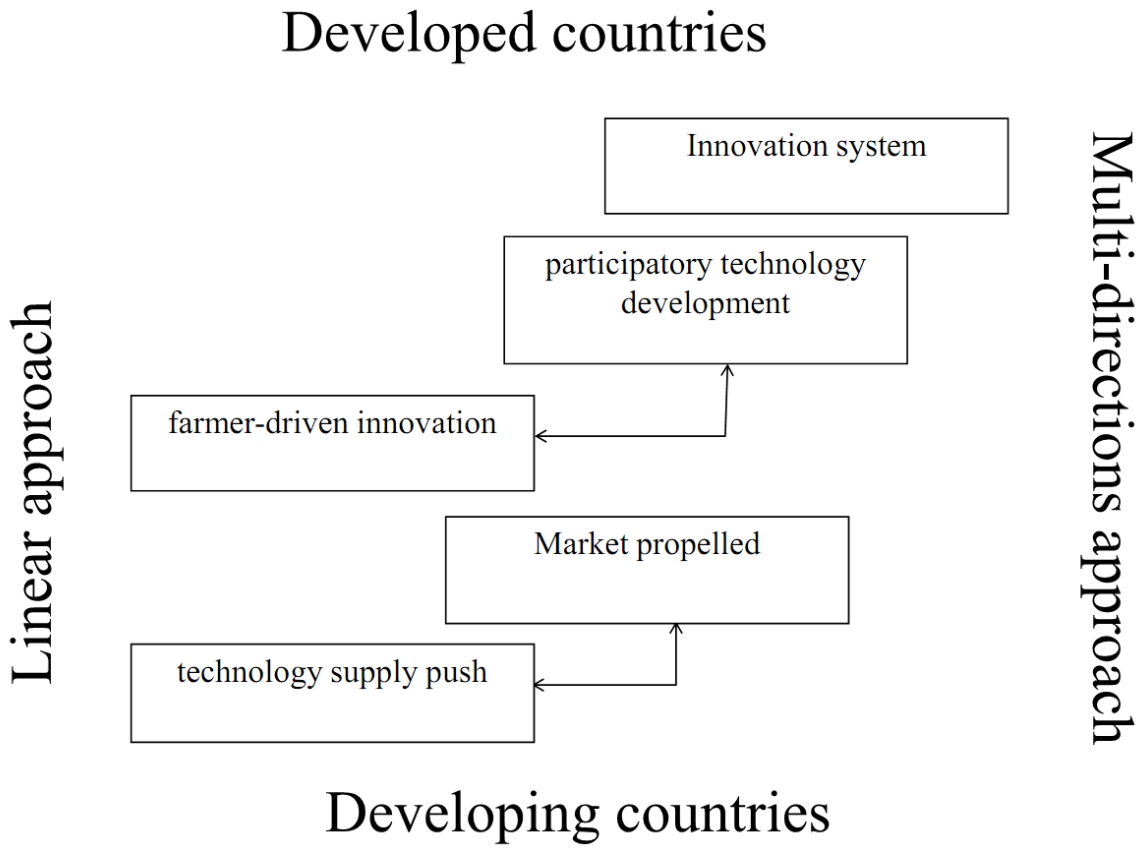


Figure 2.5: Distribution of scientist's pathways for science impact following to research approach

Source: Adapting from Röling (2010).

However, it does not provide the expected benefits until sustained diffusion (spread in usage) is achieved. When the farmers decide to apply the innovations, their activities are done in a routine manner with a target of gaining economic profit. By time, their production comes into sustainable achievement and has impacted on other producers with disseminating effect, we call such situation is the diffusion of innovations. The entire process of diffusion, therefore, starts from the adoption of innovations and continues through various stages of infusion, reutilisation, adaptation, etc. until the innovations become obsolete (Rogers, 2003).

Starting from the position of creators as individuals/organisations who produce innovations or play as the sources of information about innovations, innovations are transferred to applicators under certain circumstances and certain objectives. This situation frequently happens when an agricultural firm tries to create its owned material zone. This section will consider market research and its approach towards the diffusion of innovations. Three factors relevant to the adoption of innovations: (1) the forms of marketing communication used to introduce the product to those affecting the rate of diffusion, (2) the compatibilities of innovations are going to be transferred, and (3) the support for applicators during the process of application as well as after crop harvest as the market for agricultural outputs.

Regarding to the objects as innovations those are going to be transferred, qualities of the innovations relevant to adoption include costs, risks, and related matters (Brown, 1981; Morrill et al., 1988; Hagerstrand, 1967 cited by Redmond, 2004). Rogers (2003) has also indicated that “relative advantage”, “compatibility”, “complexity”, “trial-ability”, and “observability” are also affecting qualities of the innovation.

Röling (2010) recently examined agricultural scientists' pathways for science impact (Figure 2.5). Five pathways are regarded within his research: (1) technology supply push; (2) farmer-driven innovation; (3) market-propelled or induced innovation based on the agricultural treadmill; (4) participatory technology development; and (5) innovation system. Respectively, the approach of research in these pathways is shifting from linear approach to multi-directions approach. Looking at the used terms in each model, we can see a frequent of word like "technological transfer", "R&D", in linear models, while other words like partnerships, networks, coalitions, collaboration, and linkages used increasingly in innovation model frequently (Röling, 2010).

In the agriculture, we can categorise the approaches of research on diffusion of innovation into three main categories as following.

- The first category of approaches focuses on the way of communication (or interaction) and socio-cultural resistance to innovation on the pattern of diffusion over time. The primary objective is to understand how these factors determine the means of communication that effect upon the rate of diffusion, and how socio-cultural and economic characteristics of the adopters create a spectrum ranging from innovators to laggards. Recently, many researches in this area have discussed the structural changes as the essence of development and communication as

complementary in the adoption process. It is argued that unless the institutional context is favorable for development, communication behavior and personal attributes of the individuals contribute only a limited effect of the innovation-diffusion process.

- The second category of approaches focuses on how economic variables such as the profitability of an innovation and the asset position of adopters influence the rate of adoption. This approach views peasants as rational economic actors who are willing and able to respond to economic opportunities. In these situations, the researches intend to clarify what would farmers expect from the adoption of an innovation and how is about the opportunity cost.
- The third category of approaches focuses on the consequences of innovation adoption. This approach is concerned primarily with analysing the changes that have occurred following the adoption or rejection of innovations. Recently, many issues such as gender issue, inequality, local democracy and the participation of farmers in the local decision process, etc. have been emerged as key issues in the public discussion. Therefore, the effect of application of advanced S&T achievement in the rural areas and agriculture should also be related as one of the solutions and the consequences from the application of such innovations should be clarified.

Hence, a cognitive explanation of peasant receptivity to agricultural innovation should consider a wide range of factors within villages and should fit to local conditions. Many factors have been recognised including the social structure, the structure of land tenure, of political participation, of economic segregation (both class segregation and lack of integration into the national economies); the inequitable distribution of wealth, of services, of legal privileges and of rights, etc.

Referring to the aspect of ownership and use rights of the invention, the perception of transferring technology to farmers is stated more closely, focussing on the rights and duties of owners and users of innovations. “Technological transfer is the transfer of ownership or use rights of a technology partly or fully, from owners of this technology to receivers of this technology” (Law of Technological Transfer, article 3, paragraph 8)[12]. Thus, when an invention is registered officially to a responsible agency, it will be protected and dominated

[12] Law of Technological Transfer, Nr. 80/2006/QH 11 is issued on 29 November 2006 by Vietnamese National Assembly

by this regulation. In fact, the transfers done by organisations or enterprises are normally applied this regulation to adjust the behavior of involved partners, in order to develop a vast material zone or forming a commodity production.

Using a more closely term "diffusion of innovations", Rogers (2003) has defined diffusion of innovations is “the process by which innovations are communicated through certain channels over time between the members of a social system”. The diffusion of innovations consists of a series of different actions that occur over time. By this concept, Rogers (2003) has identified four main elements in the process of diffusion of innovations, including: (1) innovations, which are going to be transferred; (2) channels for transferring innovations; (3) individuals/organisations are involving in the process who might form a social system; (4) and the factor of “time” that relates to the “rate of diffusion”.

- The first element is innovation that might be “an idea, practice, or object that is perceived as new by an individual or other unit of adoption” (Rogers, 2003:12). In agriculture, the innovation might spread from the fields of applying high technologies as computer, micro-chip, in production’s management, implementing modern mechanical techniques in production, post-harvest and food processing, applying bio-technological innovation relating seed and advanced variety, implementing advancement in maintaining the sustainable development such as inter-crop method, organic farming, insect protection management.
- The second element is using channels for transferring innovations to adopters. The flow of innovation towards adopters may start from the need/willingness to solve the problem of receptors that are faced with this problem, or from a commercialisation of an innovation invented by a R&D organisation, or from the willingness of extension agencies to disseminate an innovation in a certain region. Therefore, channels for transferring innovation to adopters are fully available in an open economy where the demand and supply of applying innovation exist, and also the role of government in supporting the implementation of innovation in agriculture is actively observed. The different types of channels may range from private co-operation or commercialisation to public supporting of state agencies as the state extension services. However, recognition of the mechanism for operating such channels in the reality is complex and not simple.

- The third element is individuals/organisations, which are involved in the process of diffusion of innovations. They are receptors of innovation, suppliers of innovation as well as intermediate agencies, which are supported throughout the process of diffusion of innovation. We call these, individuals/organisations, actors of the process. These actors, in some certain situations, act as economic entities with the willingness to maximise their economic profit, or as supporters with aim of achieving sustainable development within the region. Their behavior reflects their own strategies and is affected by others.
- The fourth element of the diffusion of innovation is a factor of "time" which refers to the terminology of the "rate of the diffusion". Each innovation requires certain of time for disseminating from the suppliers to recipients. Tracing the spread of an innovation through a certain system over time also means observing the behavioral changes of all partners involved in the process, and other influenced factors.
- In research relating to the diffusion of innovation carried out by Subramanian (1996), two categories of innovation researches were suggested: innovation process research and innovation variance research. Research for the first category focuses on the process of diffusion of an innovation in organisations and industries, while research for the second category focuses on understanding the nature of the relationship between adoption of innovation by organisations, their external environment, their internal characteristics and performance. After successfully approval of the application of an innovation, it would be introduced to all users respectively. As such it takes time for them to adopt it. During the process of distribution, the widening and epidemic effect has occurred.
- In a broader sense, the diffusion of innovative advancement involves the spread of newness through society, which entails broad-scale changes in both behaviors and perceptions (Redmond, 2004). "Diffusion process reflects a communication process, especially as concerns the spread of information and the timing of individual adoptions" (Rogers, 2003; Robertson and Gatignon, 1987). New technologies can influence the marginal productivity of productive factor and hence exhibit either capital-saving or labor-saving effects. In conjunction with approaches, many definitions of "diffusion/adoption of innovation" have been raised simultaneously.

Box 2.8. Testing before transferring

De facto, many problems and difficulties happened if the innovations are not tested causing to be harmful to environment and agricultural production. For instance, the movement of diffusing and adopting yellow snails coming from China to Vietnam in previous years in order to provide food for poultry production has led to a serious yellow snail diseases in all fields of Vietnam when snails were escaped to natural environment. Yellow snails have destroyed everything, all crops, plants by their voracious causing to the decrease in yield of crops. In addition, yellow snails have an incredible quickly reproductive rate and in a very short time, they are multiplied in a large scale. There are no way to eradicate them from the field and a lot of time and money are used to prevent their devastation. Currently, they are still destroying crops in the fields. Therefore, this warning should be taken into account in designing a program of transferring a new thing to farmers.

Hence, in this study, the process of transferring S&T's achievement to farmers is understood as the process of encoraging the co-operation among partners to diffuse S&T's achievements whose stable value, typical characteristics have already been confirmed in the practical experiment, to farmers in order to apply in their production for getting profit and satisfying market demand.

In this definition, two terms should be explained in details.

- The first term is "diffusion": it contains many operations from introducing the improved information, explaining, persuading, providing incentives for applicants and support for them in the application process, providing incentive to enhance the linkage between partners.
- The second term is "typical characteristics": it contains ten typical characteristics as observability, visibility, communicability, profitability, trial-ability, reliability, flexibility, compatibility, complexity and relative advantages.

This definition contains basic parts:

- Transferring S&T's achievement to farmers is a process, which has many stages or phases in a certain period. This time is not only for creating relationships among partners (establishing an agreement, introducing and implementing innovation within the field) but also is the amount of time required for growth of crops and the rearing of animals. The length of time for these cycles depends on the type of crop or the animal. The spread of a new idea relates to a special factor – “time” and it

occurs through a structure of a social system. When “time” is involved in the research on diffusion of innovation, a terminology of “rate of diffusion” appears in the discussion. It implies that one innovation could be disseminated faster than the others, but this does not mean faster is better. This is because the behavior of farmers is not always the same, as some will follow strict guidelines (that are available) when applying innovations whereas others will act on their own understanding. As such, researches on the diffusion of innovation have main objectives of exploring the behavior of all actors in the process, changes in structure of a certain social system in certain constraints. Furthermore, the challenge for research on transferring and diffusion of innovations, especially in agriculture, is to provide an economic context to understand the behavior of economic entities facing radical uncertainty and multiple possible outcomes of their choices (Antonelli, 2003).

- Transferring innovations to farmers might be carried out through different channels, where, many different actors are involved with different operating mechanisms, control and monitoring. Therefore, the forms of transferring innovation and the set of initiatives used are not the same in different situations, but they are similar in one respect: strengthening the linkage between involved actors in innovation.
- The innovations included in the process vary, not only in the achievements of science and technology developed by R&D institutes, but also the know-how or knowledge collection and selection process from farmers' experiments. The stability of these innovations should be confirmed as well as their characteristics before being applied.

2.2.2.2. The means of diffusing innovations

Redmond (2004)has identified two types of diffusion, which depend on the two types of motivation to adopt an innovation: cohesion and equivalence.

- In the cohesion model of diffusion, individuals are likely to copy the adoption decisions of familiar individuals, such as other network members (Burt, 1987). This mode of diffusion involves a co-operative spirit of communication among interested individuals (Frenzen and Nakamoto, 1993; cited by Redmond, 2004). Communication between individuals with similar statuses and interests is thought

to be significantly more effective in stimulating diffusion of innovations, as compared with random contact (Rogers, 2003; Redmond, 2004).

- In the equivalence model of diffusion, individuals are motivated by competition with others (Burt, 1987; Redmond, 2004), and they maintain a high awareness of other's behavior. A potential adopter evaluates the costs and benefits in line with his or her position and, in doing so, seeks information, which will clarify the social meaning attached to the innovation by others in similar positions.

Regarding the rate of diffusion of innovations, there are two main types of diffusion of innovations including fast diffusion and slow diffusion, in which the situations are explained by two ways: (1) by the theory of product life cycles and, (2) by considering the social system through which the innovation diffuse (Derorïan, 2002).

Traditionally, word-of-mouth has been the main channel to communicate information, especially within rural areas (Dodson and Muller, 1978). Since then, many forms of disseminating information, particularly information regarding innovations in agriculture have been used, specifically, modern mass media such as television and radio and training courses.

2.2.3. Typical forms of transferring S&T's achievement to farmers

When measuring the development of the diffusion of an innovation, it is clear that two important factors should be taken into account: "time" and the "number of adopters". Rogers (2003) has drawn an S curve to demonstrate the relationship between these two important factors (figure 2.6). The actual demonstrative line of diffusion of an innovation may not be smooth like theoretical ones. The slope of the line represents for the rate of diffusion, and also differs in different point of time. However, in a long-run period, the process of diffusion of an innovation forms an S-curve as shown in the figure 2.6.

Generating from practice, the process of transferring innovations has been developed for a long time in the economy. Abundance of methods, arguments and theories have been emerged and experienced practically. The process has been practiced many forms, including Transfer of Technology (TOT), Adoptive Technology Transfer (ATT), Farming System Research (FSR) (Ellis, 1992). Recently, a new form has been emerged from the requirement of practice called Farmer Participatory Research (FPR) (Daniel, 1992). The FPR model is the most recent and has been used in a number of countries while the TOT model focuses on the conventional process of technology transfer with a clear distinction

between research, extension and farmers. In this model (Transfer of Technology) (Röling, 1994:246), "technology transfer focuses on technology generation by scientists, and passing on to farmers via extension. Farmers are considered as passive receivers of expertise from outside. Adoption is usually only possible under three conditions: (1) If technology transfer focuses on farmers who are helped through other sources (such as special projects) to acquire credit and inputs; (2) If technology transfer focuses on rich farmers or; (3) If the technology transferred is carefully targeted to the conditions of designated farmers, which requires collaboration between research and extension, and farmer influence on technology development".

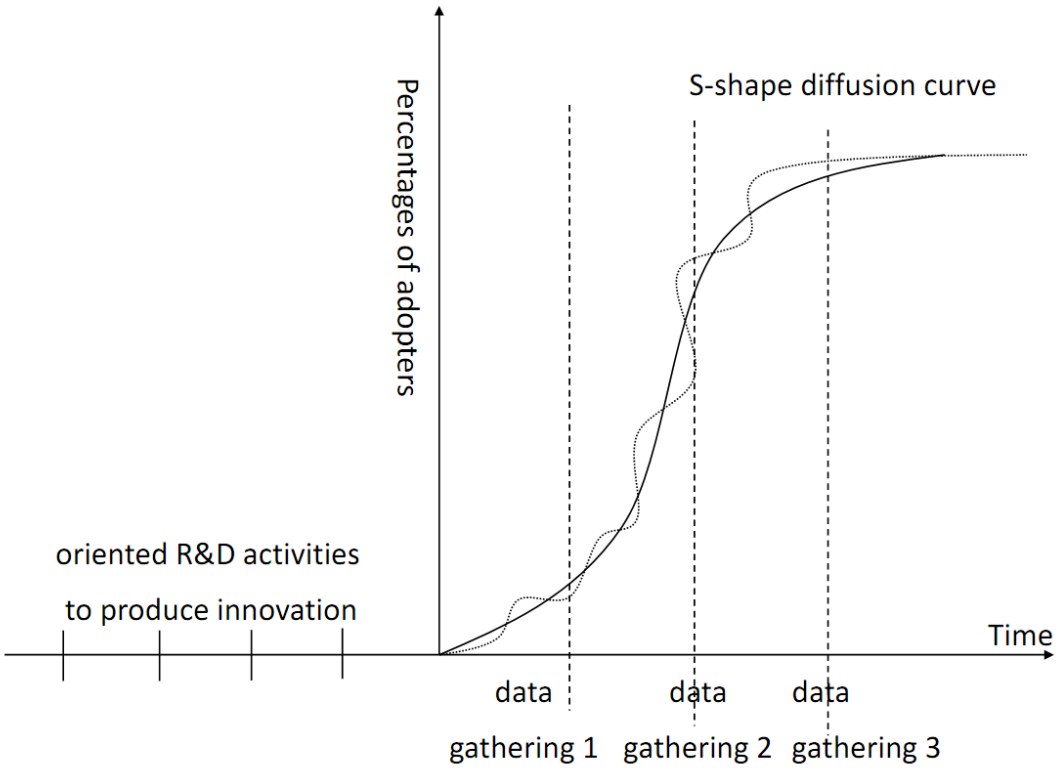


Figure 2.6: S curve of the innovations diffusion

Sources: modified from Rogers, 2003.

However, farming nowadays is much more diverse than in the past. The old linear model of technology transfer as mentioned above is therefore, outdated and should be replaced by interactive models, which combine all actors in an interactive environment such as "model of beginning from farmers" and "model of multi-sources improvement". Concretely, many prototypes of interactive models dealing with diffusion of innovation have been

formulated, among which: models on information contagion (Derorïan, 2002), herd behavior (Kirman, 1993), network externality (Arthur, 1989 cited in Derorïan, 2002), or contagion of conventions (Morris, 2000). It would say that by such those models, agents are situated on a structure of connection under the certain institutions. All of agents and their interaction create a social network, which constitute institutionalised foundations to individual preferences and decisions. “Hence, the situation of agents within the network is emphasised as providing differentiated values for individual actions” (Derorïan, 2002). The majority of these models have been formulated and developed due to a requirement of improving the efficiency of transferring innovation to farmers. There are three typical approaches used within the models. The first approach is top-down considering a nature of linear and one-way impact, focusing on the flow of technologies from university or research and development institutions to farmers linearly. This approach is originated from a willingness to transfer innovations directly from creators to users without the attention of differentiation in practice. In that case, it does not adequately address the specific issues that may arise. The second approach is bottom-up approach, which is often seen as the opposite to the top-down approach. Starting from practice, although, this approach may (attempt) solve every specific problems directly, but as a result is highly complex, lacking an overall view, without synchronous and is often fragmentary. Therefore, a combination of top-down and bottom-up approaches was developed, which take all advantages of involved partners, from farmers to research and development institutions. The disadvantage of this approach is the operational expenditure is too high, timely and costly in contacting. However, faced with a requirement to construct a highly specialised agricultural system specifically focused on commodity production and with increasing competition, the third approach seems more appropriate.

Hence, in summarizing, the Transfer of Technology (TOT) and Adoptive Technology Transfer (ATT) apply a top-down approach, the Farming System Research (FSR) applies a bottom-up approach, while Farmer Participatory Research (FPR) applies a mix of the above approaches (Ellis, 1992).

2.2.3.1. Transfer of Technology (TOT)

The TOT approach during the 1950’s-60’s was very popular worldwide (Ellis, 1992). The outputs of research were often organised and conducted completely in research and development institutions, before transferring to farmers through agricultural extension agents. The result of the research should contain "modern technology" suitable for large-

scale production, but do not concern the appropriation to small-scale production (see also indigenous conditions for applying innovations in agricultural production). Therefore, these outputs are mostly suitable for a modern agriculture, well invested infrastructures, large-scale production, high investment capability, and incompatible with small-scale production of farmer household. The ecological environment and social conformity aspects have not been considered appropriately and farmers as the users of technologies have been imposed to apply innovation passively. This means that they are simply told to implement an innovation without any communication with outside suppliers. Moreover, transferred innovation does not fully serve the demands of farmers, and it is very difficult to integrate those things to their life. Therefore, many programs following by this approach failed (Chambers and Ghidyal, 1985).

2.2.3.2. Adoptive Technology Transfer (ATT)

Overcoming the weaknesses of TOT, such as the compliance with locality, relevant to socio-economic conditions and social concerns have been addressed. Typical model of this form is the well-known system of Visit-Training (Benor, Harison, Baxter, 1984; Frank, 1992; cited by Daniel, 1992). This model is built locally on the certain field, then extension workers organise technical training for farmers in combination with visiting the sample model in practice. Farmers will apply innovations based on gained knowledge and observation from an actual model. By this method, the technical innovation is transferred directly to active farmers from research and development organisations through the support of extension services. Although this method has had good results, however most focus on farmers who have strong economic capability and the support of a well-operated input market. As such, this method seems to be inappropriate for small-scale farmers whose economic capability is weak, or farms run by weaker groups for example old farmers and those run by women. These farmers do not have enough resources to invest in their production as recommended by extension agents, or due to psychological factors as self-esteem and low political position, they have little access to innovation demonstrations.

Selener (1989) (quoted by Daniel, 1992) has summarised the advantages and disadvantages of T&V systems as follows:

- The T&V system was created primarily to spread technical recommendations, without attention to farmers, whether they might be able to invest and operate the technology as recommended or not.

- Indicators of investment requirements, types of inputs are high, such as fertilisers, pesticides, seed, water ... that poor farmers are often difficult to meet, as well as their production is not consistent.
- The job of popularising innovations requires a large number of highly educated staff, which extension organisations can't satisfy. The quality of extension staff also affects the capability of receiving and processing feedback from users, which reduces the adaptability of technology.
- Participation at farming training courses it often not 100%, especially for poor farmers with a limited understanding the necessity for participation. Therefore, the training programs are not as effective as they could be.
- Models for demonstration often choose the typical peasants who are often fairly well off. Models do not take poor farmers or less power farmers into consideration.
- Since the introduction of technology into practice it has only focused on farmers who are better-off however generally it does not take poor farmers into consideration therefore, feedback from farmers to research organisations through intermediate organisations (extension services) will not cover the opinions of all farmers, including poor farmers, less power farmers. This limits the feedback from users to creators, and innovations could not adapt to reality.

Thus, theoretically, although the model of T&V of ATT has focused on creating a practical and accessible model for farmers, in practice it has not been comprehensively and completely organised. Therefore, a different method needs to be formulated to allow the efficient transfer of innovations to farmers.

2.2.3.3. Farming System Research (FSR)

At the end of the 1970's the Farming System research method was born (Daniel, 1992; Shaner et al., 1982). This focused on:

(1) Dependent relationship between component elements of a farm, and the relationships between farm and partners in the economy;

(2) To increase the efficiency of agricultural systems, to promote creating innovative technologies and improving these technologies;

(3) Recognising the importance of local knowledge should be included in studies into the development of new technologies. Farmers should play an active role and the farmers involved throughout the process should, includes rich and poor farmers to ensure fairness.

However, the implementation of this method was not effective due to difficulties arising in the implementation, for example:

- Although the participation of farmers is equal, researchers and extension staffs continue to transfer in the same way ignoring poor farmers. This is due to many reasons, but mainly due to access difficulties, as well as the ability to attract poor farmers to participate in the activities within the project.
- The agricultural system includes many components, therefore, researchers are unable to collect all the available data which results in the data to be stretched during collection and processing. In addition, it is too complex and difficult to summarise causing difficulties for researchers to deal with a specialised field, which is outside of their knowledge base. In fact, it is difficult to train further qualified professionals with an in-depth understanding of all the areas of agriculture, therefore, researchers often have difficulty in working with multidisciplinary issues.
- The links between farmers and researchers is often loose, due to the interests of both parties being undefined, as well because of differences in perception where there is a gap between them in recognising (potential) issues.

Due to the limitations stated above, the transferees are turning to other forms of transferring innovation to farmers whereby the participation of farmers is welcomed and recommended for the successful of the method.

2.2.3.4. Farmer Participatory Research (FPR)

A new form of transferring innovation to farmers called Farmer Participatory Research was developed to overcome the limitations of previous methods whilst retaining the advantages. Due to the recognition of previous models weaknesses, a new approach was developed:

- Farmers and researchers identify the problems at the farm gate.
- Professionals and farmers discuss and find solutions to overcome difficulties.

- Farmers under the guidance and supervision of technical experts would conduct testing technology in practice. This testing process may be extended based upon the growth cycle of the organism (if relating to biological organism), or managerial practices in an economic cycle (if relating to economic issues).
- At the end of a cycle, experts together with farmers summarise the whole process and could provide recommendations for diffusion. These results could then be used in institutions and diffused.

Looking at the above steps, the basis of this approach is to maximise the participation of farmers. In the history of agricultural extension, FPR has also been known under different names such as farmers back to farmer research, or Participatory Technology Development), (Rhoades and Booth, 1982; Tanny and Derzko, 1988).

A main aspect of this approach is the positive active participation of farmers in the whole process, where studies are carried out directly on farmers' fields. As such, it attracts the participation of majority and focuses on improving crop yields and livestock as well as improving the effectiveness of tried and tested methods. When a project is carried out in this way, researchers would play the role of discoverer as well as an adviser and friend for the farmers. The support of experts may help farmers maximise their indigenous knowledge. During collaboration, partners will participate flexibly and encouraging creativity.

- Farmers are informed of all the different activities, creating a close co-operation between farmers and experts directly within households.
- Maximising the participation of farmers fairly and equally among groups such as rich and poor farmers, male and female farmers, as well as young and old farmers; and encouraging the participation of disadvantaged groups, providing them an important role during the implementation.
- Farmers are regarded as experts, with an equal status to that of researchers and extension workers. Farmers are the people who have known best about themselves, who have rich experience and indigenous knowledge, knowing how to adapt to changes of outside factors. Farmers may learn best from farmer’s, and sometimes this learning process brings incredible results.

- Exchange process between researchers and farmers should be considered as a mutually beneficial process for both, in which scientific knowledge and indigenous knowledge will support and bond together.
- In the implementation, the farmer's are the main actors in determining problems, solutions and evaluation. Researchers and extension agents will assist farmers to supplement the necessary knowledge, and ultimately, their results may lead to technical recommendations. The implementation is carried out mainly by farmers and therefore, the model is not formalised by extension workers.

However, during the implementation stage, this approach reveals its limitations, as indicated by the following:

- Some researchers and extension professionals find difficult to accept the leadership of farmers, even if they contribute positively to the process. This is due to their insistence that scientific knowledge gained through many years of study and practice is accurate, and they underestimate local knowledge and experience.
- Farmers themselves also feel psychological inferiority, that they have a lower status than their partners do. This comparison can also be drawn between other groups of farmers, between rich and poor, men and women, young and old.
- The daily running of t of the farm is usually not scheduled for specific time in a day, and may include a large work load . Thus, under the pressure of housework, some farmers cannot participate the entire time of training.
- Farmers have been characterised as selfish, conservative, distrustful and strange. Any previous failures also have a negative impact on them, which affects the implementation of next programs. Sometimes, this mentality is also aggravated by imposed communication with researchers and extension workers.

2.2.3.5. Methods used in transferring S&T's achievement to farmers

After determining the different approaches and forms of conducting innovation transfer, the next step is to find out which methods could be used to execute specific tasks in practice. The workload can be divided into several parts, including planning, identifying problems, determining solutions and performance evaluation. There are also a number of methods which can be used to communicate with farmers, specifically group contact, personal contact, and using mass media by support of communications. Further to this,

when considering implementation, there are methods of: (1) general approach; (2) specific approach; (3) organising a model of Training and Visit; (4) participatory research; (5) implementation by project; (6) conduct research within agricultural systems context; (7) commitments of the sharing project's cost; and, (8) access to farmers by educational institutions (Geoger, 1992; quoted by Daniel, 1992).

The definition of the methods used to communicate to farmers, are as follows as:

Method of group contact: This method determined the propagation and dissemination of knowledge, and information is conveyed to a certain group of farmers. This method is mostly used in the model for demonstration, training and visits, on-field conferences and group meetings. Through this method, researchers and extension workers provide groups of farmers with information on technical advances, helping the team to get new information. Flyers, brochures, guidelines may be sent to members in the group during the implementation process.

Method of personal contact: This method can be defined as the dissemination of knowledge to individual farmers or to specific farms. Staff may exchange letters with farmers, call, or visit them directly to help farmers deal with specific issues. However, the drawback of this method is the lack of staff, as there are not enough for all the farms and farmers. Therefore,, staff tend to only come into contact with rich farmers, rather than poor farmers in remote areas.

Method of using mass media by support of communications: This method is focused on the creation of a mass media channel that is specific and universal to provide information to all farmers using the media for example the television, radio, newspapers, posters and advertisements. Although all farmers have access to this information, due to the spread and wide range of knowledge, the fact that it takes a long time to watch these programs, as well as the possibility that they do not solve problems directly, this method can only be considered as an additional channel for introducing new information.

Currently, Vietnam is in the process of developing its socio-economy, in which agriculture is one of the priorities. To achieve the goal of a modern and effective agriculture, and formation of specialised agricultural areas the transfer of technological advances to farmers is being encouraged. A number of efforts have been made to encourage this through policy, including the establishment of a state extension system from the national level to local

commune. Essentially, this is the official organisation within the country which promotes the transfer of innovation to farmers. State extension applies four main basic methods[13]

(1) Implementing extension works by programs and projects;

(2) Support for formation of demonstrative model on the fields, organising training and visiting, on-site visit;

(3) Extension method encouraging the participation of farmers: mainly applied in the programs and projects supported by NGOs and foreigners as training courses FFS (Farmer Field School), PTD and;

(4) Extension method with support of state funding: helping farmers for productive costs as: (i) input materials for applying innovation (occupied 30-40% of total costs), (ii) organising training workshops, on-field conference and visit the model.

Thus, these four approaches to transfer innovation to farmers can be used in combination with the above methods for example, the Method of group contact.

2.2.3.6. The rate of transfer

Why do some innovations diffuse faster than others?

The only strong evidence that has emerged from studies is that the more profitable innovations tend to diffuse more quickly than others do. It would be interesting to know whether the social structure and growth performance of adopters have had any significant influence on the rate of diffusion of innovations.

Many scholars have tried to measure the rate of diffusion of innovations by means of determining either the time-period of the distribution as the spread of the information on the profitability of the new technologies, or the number of farmers who take part in the application of these innovations. It is perhaps unnecessary to explain that it is a particularly convenient measure for current purposes, since two important factors are concerned: the factor of “time”, and the factor of “number of adopters”. The result of measurement the rate of diffusion of innovations may differ across regions, populations and field of production, because the nature of two above factors is different.

People try to understand the nature of diffusion of an innovation, as such, they should collect the data on the process. The factor of “time” also affects the approaches of data

[13] http://www.khuyennongvn.gov.vn/he-thong-khuyen-nong/lich-su-trung-tam-knqg_t92c29tn.aspx

gathering about how an innovation has diffused. This data can be gathered at many points of time while the diffusion process is still under way or only after the diffusion process is completed (Rogers, 2003; Heany, 1983). By dividing the time period of the diffusion of an innovation into small pieces of time (figure 2.6), the approach eliminates weaknesses such as asking respondents to recall information about their date of adoption of an innovation over a long time period. Therefore, collected data seems to be more accurate. Especially, when considering the diffusion of an innovation in agriculture. The method of dividing a time period into pieces has also been related to many constraints such as a biological life-cycle of the innovation, financial resources to conduct research, socio-economic cultural conditions of the locality, other infrastructure conditions to approach to farmers such as transportation as well as communicative systems.

Regarding to innovation's diffusion, farmers as adopters could hold the knowledge as to how their production could be developed and how to gain profit. The efficiency of this adoption, on the other hand, may result in encouraging the remaining farmers. Whereby the successful application of innovations of initial adopters leads farmers as non-adopters to become adopters in the long-run. (Rogers, 2003)

2.2.4. Actors involve in the process of transferring S&T's achievement to farmers

2.2.4.1. Farmers and their personality variables

"The implementation of systemic innovations ultimately has to be considered at the farm level. This is the level where farmers' decisions regarding the selection of activities, the allocation of resources between crop and livestock productions, and the management of production processes determine their farms' impact on both the quantity and quality of agricultural products available to consumers and on the natural environment" (Gal et al., 2011:715). In the process of transferring innovation or the diffusion of innovation in agriculture, farmers are recognised as the direct receptors to apply innovation in their production. They are also the target of R&D organisations, extension services, local authorities, non-governmental organisations and firms. The process of innovation adoption is also based upon the nature of characteristics of farmers, including personality variable as skeptical-distrust outsiders; conservative, reluctant to innovation; selfish, autarky; psychology of a crowd (Shaw, 1987; Foster, 1965; Robertson, 1971).

The initial characteristics of farmers are conservativeness and reluctance to innovate. In the mind of a peasant, all things desirable in life exist in finite, not infinite, quantities.

Traditional farmers have accepted the innovations when they can see the benefits. They have adopted innovations, because they expected benefits to exist or because new methods are necessary, inexpensive, subsidised or convenient. In farming they strongly prefer low-risk, low-cost methods validated by generations of local use, and because they have social validity for villagers and can be supported by the focal social apparatus (Rohrer, 1986; IAASTD, 2009).

Farmers also tend to be skeptical, for example interpersonal distrust among peasants and distrust of outsiders. Furthermore, the habit of autarkic production in the rural areas for over a number of years has caused peasants to become selfish. If the measures do not help the peasants themselves, then they would vote against them, although they would benefit the community as a whole. In the relationship with neighbors, although his position remains unchanged, he considers himself worse off if his neighbor's position seems to be better (WorldBank, 2007; Folkers, 1988).

While individual motivations are important elements as previously mentioned, other factors, that are not limited to, venture, education level, risk orientation, self-confidence, opinion leadership, and financial resources are exogenous factors to impact on the transfer of S&T's achievement as well as application of advancements in local agricultural production (Rogers, 2003; Redmond, 2004; Robertson and Gatignon, 1987; Rogers and Burdge, 1972).

Early adopters and later adopters

Two important concepts in the research of diffusion of innovation are adopter and imitator. Adopters are individuals who adopt the innovation from the beginning of the diffusion. They are also called potential adopters or early adopters or innovators while the imitators are individuals who adopt innovations later under the effect of diffusion also called later adopters or laggards (Rogers, 2003; Jeuland, 1981). With the differences between the nature of adopters, other's strategies would be associated such as management strategies, communicative strategies, decentralised/centralised strategies and perceptions of external environmental uncertainty (Miller and Friesen, 1982; Zmud, 1982; Brown and Utterback, 1985; Subramanian, 1996).

Endogenous factors of demand side and their influence to adoption of innovations

A few privileged farmers who own large amounts of land, have a high socio-economic status, and are exposed to mass media and extension education, are most likely to adopt

new agricultural technologies. Furthermore, the innovation is also disseminated faster and more comprehensively by the adopters who are on the same level of willingness/habits, education level, knowledge gaining, production experiment, and so on. It means that the capability of demand is also important for applying innovation in particular, and the homogeneity of the perspective population plays an important role in accelerating the rate of diffusion of innovations in generally. The capability of adopters differs widely in terms of both their ability to take advantages of new advanced technologies, which have been transferred to them, but also in their capability to innovate.

However, most of the attention, until now, have been focused on the adopters while the non-adopters are left out of the analysis and little is known about their characteristics. Thus, the fundamental problem of structural inequality remains ignored.

Farm's size

In agriculture, farm size is a major structural variable, with implications for the amount and composition of production inputs. For instance, farm's size is measured by acreage of cultivation land, numbers of livestock, size of invested capital, number of labors, and so on. Farm size can have different effects on the rate of adoption depending on the characteristics of the technology and the institutional setting (Gal et al., 2011; Kalish, 1985). The relationship of farm size to adoption depends on factors such as fixed adoption costs, risk preference, human capital, credit constraints, labour requirements and tenure arrangements (Feder et al., 1985). Large farms, because of their higher incomes, economic power, social prestige and links with local authorities, generally enjoy a more assured supply of modern inputs, and the credit necessary to fruitfully utilise the new agricultural technology. In addition, large farms can utilise their advantages in terms of economic scale in production, and the rate of return might be better. Consequently, the relationship between farm size and adoption behavior also varies.

The age of farmers

The age of farmers also affects the rate of diffusion of innovation in agriculture (Feder et al., 1985). Agriculture nowadays is becoming more capital intensive rather than labour intensive. Younger farmers might be better in approaching to modern equipment, modern methodology, where age and wealth are advantages. They play a vital role in the agriculture and agro-food sector, supplying their energetic entrepreneurial spirit,

innovative ideas and new ways of doing business. However, they also face specific challenges such as recruiting and retaining workers with the right skills.

Economic profitability, Risk perceiving (taking)

The desire for an innovation should come from peasants, farmers on the other hand are attracted mostly by economic profit. They act as profit maximisers. Before transforming and assimilating knowledge in their production, they normally compare costs and benefits of adoption in a given time. This calculation relates very much to the capability of adaptation, their market chance and initiatives they can get from the application. They are always scared of failure and normally wait until the possibility of success can be seen. Therefore, with the acceptance of perceiving technological complexity, newness, consumers are perceiving risks of adoption (Röling, 2010; Folkers, 1988).

By incorporating both risks and multiple objectives such as consumption needs and expected income in the decision-making process of farmers, we know more about the behavior of farmers. In a subsistence rural economy characterised by a high degree of environmental risk, the prime motivational forces behind the economic activities of a family farm are subsistence need, survival of the family and risk minimisation (Geroski, 2000; Griffin, 1974; Hagen, 1962). Risk taking, risk-averse and the willingness to develop appears to be the chief causal factors in explaining the adoption of innovations in family farms. They also determine the rate of the diffusion of innovations. Risks, and risk aversion, may be related to weather variations, imperfect information, the physical environment, farm income, and farm size. Farmers may take the risk when they decide to participate in an application of new things in a new environment of production, new conditions, but they expect for a better future.

Gender issues

In some studies, researchers tend to consider peasant farmers as predominantly male, consequently underestimating the percentage of the female population active in agriculture (Redmond, 2004). Traditionally, institutional mechanisms, relating to family labour, family income and structural and attitudinal barriers reinforce female participation in the labour force. (Feder et al., 1985)

Women also represent a significant group of producers who have been excluded or forced to limit their participation in agricultural development as a consequence of several institutional barriers. Feder et al. (1985) also suggests that: "The male gender is always

ranked higher than the female gender and determines that only men will occupy major decision-making positions and will control the valued resources within the society". Men occupy dominant status in society and in turn are justified by religious, traditional, moral and/or pseudo-scientific ideologies and beliefs (Redmond, 2004).

However, when access to resources is similar, farmers tend to act in the same manner. The operation of local women's associations has proved to be effective in allowing women farmers to disseminate innovation among members. Despite this, they are incapable of carrying out the full range of agricultural tasks.

2.2.4.2. Public organizations

Research and development organisations

In a linear model of transferring S&T's achievement, R&D organisations are a major source of innovation and a central objective of the S&T policy. They are at the core of many strategies to help farmers to achieve greater competitiveness, efficiency, increasingly high quality food products, as well as environmental protection and adequate incomes through the provision of S&T's achievement. With the support of intermediaries as extension services, scientists approach farmers and provide farmers with their products regardless of whether farmers want these products or not. "Many agricultural scientists have not developed their thinking about how the fruits of their work can help make the world a better place. This is a flaw in their professionalism" (Röling, 2010).

In a new context of rapid change, the linear model reveals shortcomings and need for an improved innovation model, where linkage among involved actors plays a more important role. "Scientists who assume that they are the experts, to whom farmers must listen will simply fail" (Hounkonnou et al., 2006:345). In order to effectively engage small farmers, research managers must invest in understanding the context within which research can make a contribution. A strong local innovative dynamic among small farmers keen to improve their conditions (except where repeated frustration has led to ritualism or fatalism) (Hounkonnou et al., 2006). As such in the new context, R&D organisations, though they are strongly conservative, just play as one among many other suppliers of innovation rather than a unique "pole" as before. This means that innovation is now not just being supplied by R&D. Therefore, R&D should recognise that next to modern knowledge, indigenous experimental knowledge of farmers is also important.

Education and Training systems

Education and training system provides the human resource for a modern agriculture. The system of education and training is a platform where people are educated, equipped with not only academic knowledge, but also experimental knowledge and help teach people logical thinking.

In the new context, education and training do not only teach people, but also participate in research to generate invention, provide experiment knowledge and provide chances for people to approach information about innovation.

Extension service

The extension service is the organisational vehicle of technology transfer and should be designed to be an effective carrier of information communicated both ways. In other words, agricultural extension workers play the main role as a bridge between farmers and creators of innovations (Röling, 1988). Through these kinds of activities such as visiting and training; interaction; pilot implementation and so on, innovations are transferred to farmers who are willing to adopt to satisfy their needs or to solve their problems.

Hounkonnou et al. (2006) has suggested that extension services act as a bridge to provide farmers with scientific achievements in order to be competitive on the market. Moreover, as Rohrer (1986) counsels, extension workers who know and positively value traditional technology will be better able to communicate modern methods by using language that farmers understand. In addition such teachers will be more likely to advice instead of lecturing farmers.

Many scholars have indicated that it is often the case that (WorldBank, 2007; Rohrer, 1986; Rogers, 2003; Gal et al., 2011), the extension services have shortcomings in their capability. For instance, generally they are poorly organised and are frequently subject to political and administrative abuse. The extension agents rarely have a broad farming experience and tend to be much younger than their audience and in addition may have an elitist view if well-educated. The extension agent may have such a wide range of responsibilities that little organised work gets done. They may have to contend with excessively large jurisdictions, answer to several authorities, and deal with being severely underpaid (Ballantyne, 1986). Further to this when looking at operational methods, agricultural extension has tended to emphasise a one-way passage of information that

includes the farmer rather than a two-way flow of information that includes the farmer's passing information on their problems back to the researcher.

Local authorities: Management Initiative; monitoring usage

Local authority is a major actor in the governance pattern of an innovative process in the locality. The operation of regional governance extends to land management, public goods management such as water, air, infrastructures. They also play a role in forming local institutions, issuing frameworks for coordinating related agencies and local regulations as well as local incentives for enhancing linkage between actors, and many other roles. These are all classified under different levels. Local authorities play two fold functions: as administrative agencies and supported agencies.

Agriculture is seen as a vulnerable field containing high risks in production due to the possibility of natural disasters and market failure but should also ensure food security for society (Cannarella and Piccioni, 2011; Herzfeld et al., 2011; WorldBank, 2007). Therefore, public provision of supports is necessary. It is also evident that favorable government policy combined with the appropriate institutional requirements for credit, marketing and access to production inputs can ensure that gains from new technology are more equitably distributed (Antonelli, 2003). The diffusion is rapid when the bifurcation occurs, and this raises issues for promotion investment. For instance, a policy-maker invests in actions encouraging the network formation, in order to improve the spread of information through the economy. Not just to inform the potential adopters about products, but also enable them to interact. In other words, a policy-maker may try to put together forums in which all parties can get together and communicate with each other. (Geroski, 2000:18; Derorïan, 2002)

Foundations

Currently the idea of establishing a foundation in order to provide incentives for certain operations, without bureaucratic and administrative influence to recipients, is widely preferred. "By not fitting within existing bureaucratic procedures, government agencies often find it extremely difficult to administer a research grant within their bureaucratic procedures. A way to avoid this problem is to administer the research grant through a nonprofit foundation. Although this procedure adds to the overall administrative costs of an innovation project, timely and in-disrupted disbursement of research resources may create some savings as well. In most countries, this legal construct is widely accepted"

(WorldBank, 2012:41). A foundation uses several mechanisms to support initiatives and innovation projects, technology transfer, and human resource development. These initiatives are arranged in specific programs, for instance programs for regional initiatives led by stakeholders and representatives of an agro-food chain in a particular region or territory. Alternatively, programs for enhancing the joint venture activity of public research institutes and universities as well as private enterprises to create a new technology-based company. In more concrete project, this fund also reserve for activity of generating new technology and enhancing the innovative operation at micro level of small-scale production.

Fund for operation of the foundations is mobilised from many sources including public investment and private sources. This type of coordination might very clear that "knowledge creation and accumulation are not decided just by the firm itself but are influenced by other firms and knowledge-creating institutions" (Chang and Chen, 2004:27).

One of important criteria which needs to be considered when establishing this type of organisation is the autonomy and independence in operation of the organisation. Although it is political will but it need a free space in operation under an approval framework. In shortly, "decentralised experimentation and centralised learning were important to success, along with willingness on the part of federal and state governments to let the foundations explore new instruments to fulfill their mandate" (WorldBank, 2012:75).

Box 2.9. Major principle of a Foundation

Each foundation tried new ways to support innovation and to manage its funds. Once effective operating routines were developed, they were adopted by all of the foundations. The foundations implement a number of activities, but the most relevant for this module are their priority-setting methods, allocation of funds, and exploration of new methods to foster innovation:

- Priority setting. Over the years, the foundations tried several methods to set priorities. The most important was a two-year national consultation implemented in 2002, which was the basis of all agricultural policies for the following five years. The process was considered too costly and never repeated. In the following years, each foundation developed its own priority-setting method, but they are converging on a permanent dialogue among the foundation, researchers, and important stakeholders from the different agricultural clusters. In other words, they have moved from a demand-driven, linear process to a continuous dialogue that results in participatory research and innovation (there are several modes of participation, however).

- Allocation of funds. For many years, the foundations used a competitive fund to select the projects to be funded. In 2006, they realized that this method did not induce researchers to abandon their linear vision of science, and they started to contract research and innovation projects directly with research institutes and other service providers. Additionally, the foundations started to prioritize projects presented by groups of actors (usually farmers and researchers) that had developed stable relationships.

- New methods. In recent years, some foundations have played a catalytic role in the emergence of innovation networks that explore new research and diffusion methods. These activities have not been evaluated yet.

Source: WorldBank, 2012.

2.2.4.3. Private organizations

"The incentives to change in commercial firms are provided by markets; the incentives in nonprofit organisations come from their associates, their own sense of duty, and the pressure exerted by donors and governments. This pressure usually is convened through two channels: funding and policy dialogue" (WorldBank, 2012).

Agricultural enterprises and their role in application of advanced technologies in agriculture

The role of firms in the development of agriculture has been widely recognised in consciousness of society, for example providing a market for agricultural output, investing capital and techniques for production, and helping farmers to change their structure of production as well as the structure of crops. In addition, helping the region to move into a stable economic structure and attracting agricultural labour in the field. Further to this even participating in generating improved technologies or importing favorable technologies from abroad for applying in the region (Zenobia et al., 2009; Lundvall, 2007; Cernea et al., 1984).

Commercial firms do always look for profit, but "there has been strong interest in promoting organisational learning as a means to establish and maintain their competitive edge" (Horton and Mackay, 2003:129). In a commodity production, the development of agricultural firms is certainly an inevitable trend. Otherwise, firms play the role of an investor for increasing demand for an intensive agriculture. Moreover, firms have been and continue to be the source of most innovations. In their operation, firms will likely continue

to lead innovation, including organising value chains and developing agricultural equipment and inputs. Firms also organise networks with farmers, traders, and eventually strong research teams (WorldBank, 2012: 28). There are three types of like associated with putting firms at the forefront of a network:

(a) Vertical links with customers and suppliers;

(b) Horizontal links with competitors and other firms providing complementary assets; and

(c) Knowledge-generating links with universities, R&D institutions, etc (Chang and Chen, 2004: 29).

The public sector can offer incentives for firms for instance, tax rebates and matching funds. Private firms may participate in innovation networks without a commercial focus when they have a social responsibility policy.

Normally, the form of establishing the relationship between firms and farmers is through contraction. Developing a favorable contract might avoid the raising of problems as hold-up problem or vertical/horizontal integration. In addition, using contracts is a way of ensuring the stability of farmers' production. In addition to contracts, farmers may invest as much as possible to fulfill the requirement of purchasers. Sometimes, through the regulations written into contracts, firms may invest input factors as fertiliser, seed/breed, or introduce new techniques, methods, and support for forming a new model. However, in many cases nowadays, firms plays as the provider of innovation as well as facilitating the sale of innovations to farmers through hierarchy agents at locality. The linkage between farmers and firms in these cases is normally basing on business relation. However, in the case of loss causing by bad quality of input, i.e. bad seed, farmers are vulnerable without any guarantee from such firms.

Non-government organisations

Next to the performance of governmental agencies, non-government organisations have also joined in the process of transferring innovations to farmers. As stated by Frantz (1987): “governments have a broader reach than NGOs do; governments target and reach society as a whole, both in social and in spatial terms, despite their dimension of class domination. NGOs, on the other hand, necessarily have more restricted and localised perspectives”. Thus, NGOs focus specifically on certain regions, and their main effort is to address specific issues. The performance of NGOs, in some cases, also appear to be more effective for a certain regions than governmental agencies do, as “governments act broadly,

they lack effectiveness in certain areas or with certain social groups, or they lose depth, objectivity, and efficiency" Frantz (1987). NGOs might overcome these problems by minimising the objectives in action, or restraint the border of applied methods.

There are also several types of NGOs. "Although almost all NGOs are formal, non-profit organisations trying to amass financial and/or technical/scientific resources to meet socially identified needs, they differ as to their affiliation, objectives, methods of action, and internal structure" Frantz (1987).

NGOs are not an isolated part to the society, and their activities should conform to the wider community. The relationship between NGOs and civil society (including R&D, institutions, local authorities and farmers) has been the subject of several studies recently, as to how they are affecting each other. There is also a broad recognition of the types condition affecting the performance of NGOs, which has been provided by the government as well as the whole society, for example democratic working environments. In an open economy, NGOs are also a bridge to connect to outside world, and a number of innovations maybe imported from the investment through this channel.

Non-governmental organisations have also stressed the importance of internal learning as a means to develop individual and organisational capacity and to empower local groups (Hudson, 1999; Kibel,1999; Eade, 1997, quoted by Horton and Mackay, 2003)

Since inventions within a closed system like a village rarely occur, ideas from outside sources are required to be transferred to villagers. The transfer and diffusion of new agricultural technologies are to a large extent a cultural communication process intended to result in economic change.

2.2.5. Factors affecting to the process of transferring innovations to farmers

Research on the diffusion process has identified a number of factors, which influence the diffusion of an innovation, and they are grouped into five categories (First four groups are indicated by Shaw (1987) while the last one is added by author):

(1) Physical factors including soil type, weather conditions and topography;

(2) Human controls over resource allocation including infrastructure, mechanical, chemical, biological and labour inputs; and

(3) Other supports such as the provision of credit, marketing and performance of extension services; and also

(4) Non-economic variables including the size and type of holding, the socio-cultural values of farmers, as well as the education and customary consumption patterns. In addition the compatibility of the technology with management practices and local environmental conditions. Furthermore, another category has also highly impacted on the process, including;

(5) Policy factors include policies of government, international trade environment, and international competition.

The first two groups refer to technical issues while the remainders relate more to organisational issues. It is better to discuss directly on the three latter groups of factors.

2.2.5.1. Supporting policies for transferring agricultural innovation to farmers

Credit support

Credit provides farmers the chance of trying either capital-intensive production or overcoming financial difficulties. Limited access to credit prevents farmers, particularly those with small farms, from employing capital-intensive technologies. Without chance to get credit from official institutions, farmers depend on the private credit market, and as such, they will probably have to pay high interest rates, which may cancel out any potential profit gains. The limitation in getting accessing to official credit sources also adversely affects small farmers in averting risks. Moreover, an inability to borrow in bad times has deterred the risk-averse farmer from adopting agricultural innovation. Therefore, a favorable credit policy would help farmers to overcome these difficulties, and in turn, they can invest for applying innovations in their agricultural production.

Infrastructure including transportation, communication, drainage and irrigation and common services

The development of commodity production or large-scale production should take infrastructure such as transportation, communication, irrigation and other common services into account otherwise achieving model production could be very difficult. For instance, agricultural research institutions have invented modern technologies focusing on high-yielding plant varieties, which provide optimum yields only if their specialised needs for water and agro-chemicals are met in accordance with specific formulas. However, adopting these technologies requires costly adjustments in farm production strategies. Clearly, these advanced technologies can take place only if the necessary requirements for drainage and irrigation, supplies of production inputs, market roads, storage facilities and

extension institutions are met (Schmalen, 1982; Steffens and Murthy, 1992). Providing such costly infrastructures requires public investment and considerable changes in institutional and organizational arrangements.

Forecasting

Due to rapid change in the world today either economic changes seen as market change and differences in customers' demand, or technical change in the development of new advanced varieties, forecasting needs to be taken into account. In adoption research, the use of forecasting tools to anticipate the speed of diffusion of innovation is relatively adaptable, particularly for the innovations in the future. The inter-connectivity phenomenon sheds light on why forecast for second-generation innovation (Redmond, 2004).

2.2.5.2. Subjective factors governing adoption of innovations

Behavior and impact on farmers' behavior

To clarify the action of applying innovations in agricultural production, in addition to factors that have a direct impact such as economic capabilities, land capability or labour capability, other factors that have an indirect impact on the behavior of farmers need to be taken into account, including factors relating to social system (sociology), culture (anthropology). These factors influence the formulation of typical characteristics of farmers throughout the region, which in turn affect the activity of applying innovation in production. In other words, the characteristics of farmers throughout the region have also affected the application of innovations to agricultural production.

Within the context of human behavior, the behavior of applying innovations in agricultural production of farmers is also influenced by educational background, and cultural influences where farmers were born and grew up. Many studies have revealed that these are very complex issues and difficult to obtain full understanding (Byer, 1996). The study of human behavior in general is the integration of researches in psychology, sociology and anthropology. These studies refer to the aspect of individuals/groups of behavior, or the impact of a social system on behavior of individuals/groups as well as a cultural impact on behaviors of individuals/groups.

Considering the aspect of individual's behavior (Nguyen, 2007) states: "behavior is understood as a reflection of the activities, actions done by people under the impact of

factors of communication, instincts, attitudes, emotions, culture, beliefs, values, power or coercion"

In classifying types of behavior, these authors also consider that peoples conduct is categorised as common or abnormal, acceptable or unacceptable behavior, aggressive or negative, instinctive or social based behavior as well as individual and aggregative behavior. Furthermore, unconscious behavior based on habits or conscious behavior, individual or collective behaviors also been classified by scholars as pertaining to people's conduct. Thus, the behavior of applying innovations to agricultural production of farmers is a kind of conscious behavior, containing the actions of social impact and is a set of conscious activities. This behavior might originate from an individual or from a group of farmers. When considering the conduct of individuals, behavior in general is considered as the observable actions deriving from the individual's feeling about a certain event. Thus, the decision, whether or not applying innovations to production of farmers, referring to individual aspects, will depend largely on the individual's awareness of innovations.

Therefore, increasing farmers' awareness of science and technology is a necessary requirement. Through the observation and other incentives, farmers would decide to apply innovation or not. Moreover, behavior is the concrete manifestation of communication. Diversifying channels of communication with farmers will enhance the awareness of farmers about innovations.

Market of agricultural products

Recently, the question proposed by farmers to extension workers and other experts who live outside rural areas is “Where can farmers sell their products” rather than “How can farmers organise their production”. Although the two issues of “organising the production” and “exploit the output market” have closely connected, the expectation of a bright “output market” has also played a very important role in persuading farmers to apply a new technology. The farmers mostly act according to the demand of market and change their production according to changes in market. Their behavior pertains to the rule of “invisible hand” in economics under the effect of “demand pull”.

A farmer may meet all the price requisites and still not adopt the innovation if the input and product markets are not easily accessible. Easy access to product markets is essential for adoption since success with innovation means higher levels of marketable production. Apart from the attraction of the direct economic gains from innovation, constraints in the

form of market availability and distance from the market may also pose problems. The lacking of incentives to adopt may be related to the innovation's marginal returns and the amount of information about it, and transportation costs. Given these constraints, the adoption potential exhibit's distance decay properties with the market centre at the peak of the surface, since marginal returns for all locations would be affected (Karakaya and Stahl, 1991).

2.2.5.3. Influence of the social network structure on innovation's diffusion

The social structure in the rural areas

Derorïan (2002) argues that a social network, conceived as influence relationships, has to convey a sufficient influence in order to spread innovations. The intensity of the links is defined by the similarity of individual opinions, and links crossing would create a network step by step. In that situation, "potential adopters, coping with the intrinsic newness of the innovation, interact with each other in order to form or to confirm their opinion about the new technology" (Derorïan, 2002). Social networks play an important role in encouraging the adoption of new technologies; however, it is also true that some networks inhibit or discourage such adoptions. Individuals strongly connected to networks whose members lack newer technology, or oppose its use, are much less likely to adopt the new themselves, and this can create an ongoing pattern or negative reinforcement that inhibits future adoptions (Redmond, 2004; Kapur, 1995).

Essentially, when two groups of extension agent share their opinions on a new technology, and they feel confident in their own opinions, they are likely to be able to learn from each other and benefit from informational exchange. On the other hand when two opinions are quite different, individuals are likely to diminish the level of received influence. Agents can be seen to be embedded in a relational network, and the opinion of potential adopters is submitted to social influence. The formation of opinions rather than referring to information transmission needs periodical revision in terms of judgments and discussions in the social system. Hence, the formation of opinions is considered as a cumulative process that gradually increases the pressure of the whole community on individual opinions (Derorïan, 2002).

Interactions are considered as interpersonal influences under a certain social impacts. Moreover, interpersonal communication influences individual behaviors. Agents consider the general characteristics of a new technology, and try to compare its level of performance

with the previous ones. Individual evaluations of the innovation strongly depend on comparisons with other agents' experiments, and there is no doubt that the impact of neighbours' experience on one's opinion is qualified by trust. Other restrictions here include time and dynamics constraints where time is discrete and the dynamics is synchronous (Derorïan, 2002).

The social structure within which individuals communicate has implications for both who are involved and what content is conveyed. Burt (1987) summarises the pivotal role of network as follows: "Actor finds themselves in a social structure. That social structure defined their social similarities, which in turn patterns their perceptions of the advantages to be had by taking each of several alternative actions: At the same time, social structure differentially constrains actors in their ability to take actions" (Redmond, 2004).

Culture and local institutional

A hypothesis, which has been widely considered, is that peasant societies are inherently non-innovative. It argues that this is due to a lack of strong drive and ambition for improvement and an absence of initiatives. Shaw assumes that the absence of innovativeness on outwardly imposed cultural repression and states that once repression is lifted peasants become militant and willing to accept change (Shaw, 1987). In the institutional and structural constraint models, it is argued that adoption can offer comparative advantages but opportunities to do so are unequally distributed; some individuals are disadvantaged by the resulting inaccessibility of the required resources to innovate. Therefore, peasant behavior should be fully oriented towards rational and economic considerations. "The extent to which peasant farmers are efficiently-minded and economically rational depends in large part on the level of modernisation. It does not seem justified to assume that subsistence farmers will be promptly motivated to adopt agricultural innovations merely if the pecuniary advantages of such acceptance are pointed out" (Shaw, 1987: p3).

Further to this, many constraints have been also identified by many scholars (Redmond, 2004) as including: (1) highly unstable markets, (2) a land tenure system which concentrates the best land in favour of large land owners, (3) insufficient roads and poor quality of transportation facilities, (4) poor distribution of modern production inputs, (5) insufficient education with little practical experience, (6) an institutional credit system

which excludes most peasants, and (7) sources of information that seldom provide relevant information. Constraints also include:

- lack of credit
- limited access to relevant information,
- inadequate farm size, farm tenure arrangement,
- insufficient human capital,
- restricted access to labour-saving equipment,
- uncertain supply of chemical and biological inputs, and
- an inappropriate transportation and hydrological infrastructure, are manifested through inappropriate institutional arrangements.

Given these conditions, the underlying corrective strategy by complex institutional structures would set out to overcome such constraints, and would require a great deal of effort on the part of all partners, in order to create favorable institutions for a better future.

Institutions can have a significant impact on the rate and direction of technological change in agriculture. They influence the allocation of resources, public research, policies regarding the use of specific forms of technology, credit granting and commodity pricing. However, there are political and economic consequences to the institutionalisation of rural resource allocation, for instance, institutionalisation significantly reduces the autonomy of small producers, by making them directly dependent on institutions over which they exert no control. Especially where a state attempts to reorganise the resource structure in agriculture for reasons of equity, centralised institutional allocations tend to conform to the existing pattern of asset ownership in rural areas, reinforcing the unbalanced distributive effect.

“Institutions are formal and informal rules and their enforcement mechanisms shape the behavior of individuals and organisations in society. By contrast, organisations are entities composed of people who act collectively in pursuit of shared objectives. Organisations and individuals pursue their interests within an institutional structure defined by formal rules (constitutions, laws, regulations, contracts) and informal rules (ethics, trust, religious precepts, and other implicit codes of conduct). Organisations, in turn, have internal rules (i.e. institutions) to deal with personnel, budgets, procurement, and reporting procedures,

which con-strain the behavior of their members". (Burki and Perry, 1998: 11, quoted by Horton and Mackay, 2003:129)

2.2.5.4. Communication and its role during the process of innovation diffusion

Flows of information and its approach to farmers

Communication is central to modernisation and is the central force for dissemination of ideas in the village. Communication is the process by which messages are transferred from a source to a receiver. In its role pertaining to agricultural modernisation, it is assumed that farmers are prevented from adopting new techniques mainly because of a lack of information, and the isolation of farming communities from information centers (Shaw, 1987). The external stimulus provided by such media as the radio, newspapers and farm journals is taken on-board by individuals and in turn provides an impetus for behavioral alteration (Rogers, 2003). Mass media exposure are highly correlated with individual modernisation variables, such as education, socio-economic status, age, literacy and family background. It is rare for the institutions which convey the information (the mass media, education and extension) to be considered part of the political economy.

Adoption of innovation is settled in a communication context, in which people are persuaded to gain necessary information for modernisation. The logic is that making people aware of innovation opportunities will lead to attitudes conducive to acceptance and ultimately result in adoption (Shaw, 1987).

In conventional adoption/diffusion, many physically communicated methods played an important role during the process such as face-to-face, word-of-mouth communication (Redmond, 2004; Dodson and Muller, 1978). “Communication technologies expand the adopter's ability to learn about subsequent innovations and shorten the time lag in both the receipt of information from others and the transmission of information to others”. (Dholakia et al., 1996; Vattimo, 1992; quoted by Redmond, 2004). The overall communications infrastructure facilitates information flow about innovation throughout society (Redmond, 2004).

2.2.5.5. Enhancing the access of farmers to information

Extending various formalizations of information transmitting

In traditional diffusion theory, advertising is believed to only directly impact on the initial set of adopters (Redmond, 2004). However, where social relevance is a substantial

motivating factor in adoption, advertising plays a much more significant role in diffusion. A role that is considerably longer in duration and wider in terms of direct influence. While word-of-mouth and observation remain relevant for later adopters, advertising has an important and continuing role in positioning the innovation to potential adopters. Through mass media exposure and interpersonal communications, it is assumed that the peasant farmer will gain information needed to create rising expectations and motivations for modernisation. Through pilots and experiment demonstration, it is believed that farmers will see, touch, and feel the reality, which is easily to show impressive motivations for adoption. Through training and visiting, farmers would be equipped with necessary techniques, knowledge as well as contacts for idea of development in the future.

Enhancing the capability of farmers in conducing information, develop the infrastructure for communication

As a result of rapid development in science and technology, many helpful technologies have been applied to life as the mega internet, mobiphone, television and so on. However, farmers should be equipped with new skills and knowledge to master such new techniques. The establishment of a common interest in new technologies raises the likelihood of future mentions of newer technologies as they appear.

The prior diffusion of communication innovations accelerates the diffusion of subsequent innovation (Redmond, 2004). The context of diffusion in developed economies has been characterised by the relative ease in making communications links between individuals and facilitated by the communication infrastructure. A benefit of communication is it will transfer the ideas from each of involved partners easily, as such even beneficiaries may get useful information, for instance, information about output market, relatively competitive innovation, and about improved methods of production.

Enhancing the compatibility of information with local condition by interactive methodology

“An important factor affecting the adoption rate of any innovation is its compatibility with the values, beliefs, and past experiences of the social system” (Rogers, 2003; Derorïan, 2002). The compatibility of an innovation reflects a sympathetic understanding of farmers about this innovation. However, in some cases, the compatibility of an innovation may not originally available in the first time of introduction. Compatibility only comes through a mutual interaction between farmers and their partners to understand each demand and

potentiality. Maintaining a linkage with farmers or with a social system broadly, may enhance the compatibility of a given innovation (Dodson and Muller, 1978).

Enhancing the information transparent

The unintended effects of marketing competition, which support acceleration of diffusion, are felt less and less by individuals with few contacts to new media (Redmond, 2004). However, motivating the efficiency of extension workers, may improve this situation. This suggestion also comes from a requirement on maintaining the linkages between actors, including farmers, intermediaries actors, and creators of innovations.

Requirement for sustainable development

Currently, the adoption of innovation is not only focused on economic profit, but also considers the effects of innovations upon the natural environment and its long-term sustainability. Normally, innovations introduced by economists and technical agencies tend to be based upon the maximisation of average yields and income. In spite of the diversity of performance of diffusion, when considering the profit-gained through the innovation adoption process, it is commonly assumed that there are three interconnected issues (Redmond, 2004):

- Variations in the resources in the individual enhanced or obstructed the diffusion of innovation.
- Adoption of innovation is the desire of the peasants. Farmers are ready to adopt innovations that they themselves perceive to be economically attractive.
- Individuals have accessed equally to innovations.

Increases in agricultural production over the last few decades have come primarily from the responses of farmers to new economic opportunities. Increasing food production is still a need in the developing world. It is also to employ labour-saving and yield-increasing technologies, barring the use of ecologically sound methods. However, it is increasingly recognised that the technology must be more familiar with environment of local farming systems.

Box 2.10. Some practical issues

- Disregard for fundamental ecological principles has been a major cause of development failure, proving both costly and ecologically destructive. For instance, the greater use of

agricultural chemicals causes the deficiency of micro-nutrients in the soil. Simultaneously, increased use of chemical fertilizers has reduced the amount of organic manures and upset the chemical balance of the soil. Furthermore, the use of fertilizers and pesticides has other negative ecological consequences. Only a part of chemical fertilizers applied to crops is actually taken up by plants. The remainder can be transported through surface or underground runoff and eventually find its way into water courses.

- Changes in crop rotation and inter-cropping patterns, in which large quantities of fertilizers and pesticides are applied, have upset the balance of the agro-ecosystem and made it extremely vulnerable. As well, application of mono cropping systems in larger and denser stands has exacerbated plant disease problems arising. Or, replacement of native varieties with new hybrids gradually decreases the total gene stock and further increases the potential risk of crop failures.
- Increased turbidity in rivers and canals from runoff results in lower fish yields.
- Fertilizer run-off from fields into streams affects fish, or, larger doses of fertilizers have such a deleterious effect which cannot thrive in water containing high amounts of nitrates and sulphate.
- Biological innovations have also brought about a marked change in the status of insect pests. Heavy pesticide use has other serious effects. It kills the pests' natural enemies in the field; the chemical residues in food have poisoned human directly and gradually.

Source: Shaw, 1987.

In reality, it has been proven that if peasants focus on short-term economic gains, they do so at the expense of environmental quality, suggesting that economic gains and the environment are competitive or even incompatible. "Unlike industry, environmental problems in agriculture are more likely to affect output directly by damaging the resource base itself, especially soils, and, unlike industry, the problem is corrected by altering agricultural practices rather than attempting to collect and treat pollutants" (Shaw, 1987).

Therefore, the application of innovations in agriculture with proven scientific methods can have a significant positive impact on the agricultural economy, the environment, and quality of life in rural communities. New technology should not disrupt the environment but be adaptable ecologically to it. However, successful adoption depends on an understanding of the local environment, both physical and sociological, the existence of suitable technology adequate infrastructures, credit institutions, and market and extension services. Technology must be desired by the farmers and it should be superior to

technology they have been accustomed to previously. Furthermore, it should be compatible with present lifestyle, and in harmony with the local physical environment. Rewarding farmers who adopt environmentally friendly technologies could be implements to ensure adverse environmental impacts as well as ensuring that the cost for technologies that may be potentially damaging to the environment is high. or by applying regulation and stronger enforcement.

2.3. The role of S&T in the development of agriculture in rural areas

2.3.1. Governmental recognition of the role of science and technology in economic development

The importance of agriculture in the economy has been recognised and proven indisputably. People always try to exploit the agriculture in best fit to their purpose. In Vietnam, over the thousand years of development, agriculture has played an important role in the economy. Before 1945, approximately 95% of the population was living in rural areas. Currently, this is still around 70% (Dao, 2000). Before the promulgation of "doi moi" policy[14], the economy had fallen in stagnation for a long time with an obsolete agriculture characterised by poor, isolation, rice monoculture, self-supporting, low and unstable productivity, and with farmers facing many difficulties. In parallel with the stagnation in the economy, further problems had occurred, especially in the rural areas (Dao, 2000).

In spite of some changes being made in certain areas during the green revolution in 1971, the application of chemical fertilisers, bio-fertilisers, the mass application of machinery into agricultural production, and the application of IPM, the level of application of science and technology in agriculture was considered as low compared to other countries in the region (Nguyen, 2011). Further to this a number of difficulties in the application process had also arisen.

The economy of Vietnam only rejuvenated when the promulgation of "doi moi" policy in 1986 occurred, particular since the appearance of Resolution X of the Vietnam Communist Party Politburo in April 1988 on renovation of managerial mechanism in agriculture. The Resolution marked a basic change in the management of agriculture of the country, and allowed the self-reliance and autonomy of all actors in agricultural production, as well as

[14] the policy has renovated the economy of Vietnamese for a better performance, has oriented the economy to the mechanism of market economy

explored the potential of a tropical agriculture with diversity of products in cultivation and livestock. Further to this, the application of innovations was previously not a controlled issue in the economy, but now it became an issue, which was a result of decision making by farmers themselves. The mechanism of self-reliance in the economy created a fundamental basis for many renovate policies that support quickly and efficiently for approaching to new achievements in science and technology.

With all efforts to bring the Resolution X to the reality, step by step, Vietnam has issued a number of policies such as the land use policy, policy for restructuring the economy in the rural areas, as well as a policy to develop co-operatives, policies for vocational training and investment in human resources in the rural areas. Furthermore, policies have been introduced for building rural infrastructure (electricity, transportation, school and medical care) as well as for extension services, rural credit, farming, and to support the integration of the economy into global economy. The policy for transferring innovations and applying science and technology's achievement in agricultural production forms one part of this system, and covers many aspects of agricultural production.

Shaping requirements from reality, the policy resolution[15] issued by the Vietnam Communist Party has stated that: “Science and technology plays an important role in developing a modern productive force, protecting environment and natural resources, enhancing the productivity, efficiency, growth rate and competitive power of the economy. Development of science and technology aims to enhance the process of modernisation and industrialisation of the country, creating a knowledge-based economy in order to reach an advanced level in the world. The development of science and technology should therefore conform to the development of culture and education. The country should efficiently enhance its internal capability of science and technology and also try to research and localised modern achievement of science and technology in the world. Formalising a synchronous system of policies those would encourage the creativity, attract nation’s talents and enhance the application of science and technology[16]. Furthermore, in the strategy of socio-economic development 2011-2020, the Government has stated that: “Science and Technology is really a dynamic source for a sustainable development”. The strategy has pointed out basic objectives for long-term development, some main solutions

[15] Resolution Nr. 02-NQ/HNTW, Session VIII, 24.12.1996
[16] Vietnam Communist Party, Program for constructing the country in the transition period to socialism, Hanoi, 2011

to achieve these objectives, and provided a vision for policy makers in Vietnam, to help them escape from the embarrassing situation of dealing with problems in reality.

Besides, dealing with the evaluation of the achievement and failure in the development of agriculture and rural areas, (in which science and technology has been considered as an involved factor), another strategy to develop the nation's agriculture and rural areas (2011-2020) has pointed out there are many indicators to measure the development of agriculture and rural areas in Vietnam. This includes the application and diffusion of S&T's achievement. Taking the role of S&T into account, the Strategy in its part of evaluating the real situation in 2000 to 2010 has stated: "S&T has been applied widely in agricultural production and it has contributed a positive impact to the growth of productivity and quality of the agriculture", or "many advancements as IPM, GAP, rural electricity, new seeds/breeds, the rate of mechanics, utilization of electricity… in agricultural production,… have been raised up". This strategy looks to a future where the economy will be characterised by an average income (MARD and Development, 2011). S&T would be an important factor in ensuring the quality of development when addressing the objectives of maintaining the growth rate and integrating to global economy. Many resources would be exploited more efficiently with higher productivity to achieve a better quality of life if the application of S&T was fostered.

2.3.2. Application of S&T and its impact on the development of agriculture in rural areas in Vietnam

Many research studies recently, when evaluating the role of S&T in the development of agriculture, have stated that S&T plays an active role in the development and growth of agriculture in recent years[17]

In agricultural production, seed and breed are the first issues that need to be dealt with. Through a thousand years of Vietnamese's experiment, seed/breed has been shown to be the most important factor in agricultural production, as stated: "good seeds/breeds always bring best results." Before the Green Revolution, agriculture in Vietnam was dominated by rice monoculture (Dao, 2000).

In the Red River Delta, rice is cultivated in two crops, the first crop is from January to May, and the second crop is from June to October. In addition, the structure of crops is not

[17] The statement has been pointed out in the Evaluation on real situation of Agriculture and Rural in Vietnam, Strategy on Development of Agriculture and Rural Development of Vietnam from 2011 to 2020, Hanoi, 2011

sustainable due to natural disasters such as tropical storms, which occur during May to October (the harvest time of the first crop), as well as cold weather in January (the time when crop is sown). The application of new seed since the Green Revolution has changed not only the crop's structure but also the way of cultivation. The propagation time for crop has been shortened, long plants have been replaced by shorter ones which avoids them being broken in windy and rainy weather. The new crop requires approximately 90-105 days for harvesting, therefore, farmers avoid the impacts of storms or cold temperatures, and they have more time to cultivate another crop or allow their field to be in fallow. Moreover, new seed allows a new way of cultivation as using intensive fertiliser, planned irrigation, or even taking the chances of utilising new machinery on the fields. Currently, new seed has been cultivated widely on the field except some specific areas where the traditional seed is still alive. According to the Ministry of Science and Technology, in the last ten years, 170 new varieties of rice have been generated, and they are mostly applied in the Red River Delta and Mekong River Delta (Nguyen, 2011).

This revolution started with rice seed and spread to other fields and crops such as maize, potatoes, beans, groundnut, sugar cane, pineapple, or industrial trees for example tea and coffee or fruit trees such as orange, pomelo, longan, mango, persimmon, apple, dragon fruit, grape, or flowers and bonsai. Similarly, the revolution in cultivation has spread to livestock, and new breeds have been generated such as pigs, chickens, ducks, buffaloes, cows as well as for aquaculture with new shrimp, new fish, and others. As a result many new models of cultivation, livestock and aquaculture have been developed such as the model of intensive fields, the model of new fruit garden, and the model of combination garden-fish pond-livestock, as well as other models for example for the intensive milking of cows, and models for chicken farms, duck farms, shrimp aquaculture, or models for regional specialties.

So the achievements in the field of seed/breed field were, firstly, developed by Vietnamese researchers. On the other hands, farmers also import innovative seed from abroad, even 80% of hybrid rice seed is imported from China (Nguyen, 2011). The application of new seed requires a new way of cultivation and at the same time, greater investment. Therefore, farmers should invest time to learn how to adapt to new requests and standards. Not only internal potentiality of farmers is mobilized but also many outside resources are called for a new agricultural production. The transfer of innovations to farmers has led to co-operation among partners of farmers, scientists, agricultural enterprises and local

authorities (four main parties). In addition to this, each interested party has to improve and strengthen their capability to adapt to new change and to meet requirements from others in the chain. The waves of “doi moi” have been spread everywhere, many universities and research institutes have been restructured as a result. Many agricultural firms have been founded. The Vietnamese stated that this movement was a co-operation between the four main parties that expresses a new approach in the process of transferring achievement of science and technology to production.

However, in reality there have been a number of constraints when new seed is introduced or tested on the field, including unskilled farmers, difficulties in implementation or uncompleted application, a lack of financial investment for intensive production, as well as a lack of extension services, and problems with fraudulent-trading among some seed suppliers. These constraints have had a bad impact on the efficiency of the process of introducing new types of seed into production..

Despite this, many other developments have been successfully introduced, for example irrigation systems. Irrigation plays a very important role in the paddy rice production. A proverb, which is conveyed broadly among Vietnamese, is “first irrigation, secondly fertiliser, thirdly attention, and lastly seeding”. De facto, many other techniques or initiatives are only considered after the satisfaction of irrigation. Drought or floods constrain the growing rate of crops and, therefore a planned/controlled irrigation system provides a chance to increase productivity. Furthermore, some models, which combine irrigation system and fishery, i.e. fishery in irrigation's water basins, or fishery is also developed in many cage-rafts on rivers, on canals, or combination between irrigation and hydroelectricity. However, although the irrigation system including dykes and drains, water basins, rivers and canals, agricultural hydraulic engineering, and many interior objects such as roads and irrigation systems, are invested synchronously and cover a broad region, it only serves for the delta regions under the normal conditions. Many difficulties have occurred such as weaknesses of dyke systems, obsolete pump houses and others. Therefore, thousands of hectares of annual crops and perennial plants are lost through flooding or drought every year. In addition, hydraulic engineering enterprises do not perform their role very well, especially since the cancellation of the irrigation fees.

In addition to irrigation the methods of utilising fertiliser have also influenced the productivity of paddy rice. For thousands of years, organic fertiliser has been used for paddy rice production, and it appears to be suitable for a more ecological way of rice

production. Since the 1960s however, chemical fertiliser have been widely utilised. Despite this, bio-organ-fertiliser have also been used and a combination of these different types of fertiliser allows farmers to achieve greater cultivation productivity as well as protects soil's quality. In the years of a control, planned economy, due to supply limits, chemical fertilizer was utilised parsimoniously (Dao, 2000). However, under the opened economy, not only did domestic chemical fertiliser companies expand their production, but also a large amount of chemical fertiliser was imported from abroad, as such chemical fertiliser gradually replaced organic fertilizer. Currently, chemical fertilisers are used for all crops broadly, especially vegetable and paddy rice. The typical chemical fertilizers in Vietnam are nitrate phosphorus, kali and NPK combination (Dao, 2000). On the one hand, chemical fertilisers could help farmers' achieve high yields, and greater productivity, however, the overuse chemical fertilisers could have a bad impact on the environment causing the compaction of soil, safety issues including hygiene and problems surrounding the safety of using agricultural products, lower the efficiency of fertiliser.

Another factor is, crop protection, although it does not enhance crop productivity, it protects them from damage caused by diseases or insects. Intensive agricultural production means that land is utilised intensively without a fallow season, therefore, many pathogens are present and are not completely eradicated. In comparison to traditional varieties, the new varieties are not as equipped to protect themselves from harm and heavy damage by diseases and harmful insects occurs. Many diseases as stunt strain disease, and stink bug, still exist however the utilisation of pesticides limit these damages. However, it also kills natural enemies. As a result, diseases and harmful insects can return robustly, and farmers have to use more pesticides, shortening the user-cycles and, harming the natural enemies even more. In order to deal with this problem, the method of IPM was invented to prevent the overuse of chemical substances. Although many efforts have been made through extension services on all levels, and a number of training courses organised to help prevent this, this method is still not utilised effectively as expected. Moreover, just considering profit in the short term without taking care of the health of customers. Some of the farmers have abused the application of chemical substance, which has had a bad impact on product quality and safety. Many agricultural products are created in a way where chemicals have been overused and leave residues that poison customers. To solve this problem, once again, and adapting from abroad, a new standardisation has promulgated to agriculture called VietGAP. VietGAP is a new managerial procedure including many standards, techniques

those are in correlation for a full time management. With VietGAP, people expect clean production where all agricultural products are safety for customers and the environment.

In another agricultural activity, animal husbandry, veterinary medicine has a great impact on the result and economic efficiency of the production. This is especially apparent with animal food. Previously, livestock and poultry have been considered as an auxiliary activities in a household's farming, and food for them is collected from agricultural by-products, or people's food waste. The founding of the animal feed industry has provided a new chance for development, and promoted the introduction of intensive animal husbandry farms. The number of animal husbandry farms has increased rapidly, and innovations have been broadly applied including new breeds, using industrial food, veterinary medicine, farm building techniques, hygiene and safety techniques, and others. In addition, clean and safe animal husbandry requires not only an abundance in food supply but also adequate veterinary medicine. Along with the development of animal husbandry farms, many diseases have been transmitted caused by pollution and in-hygiene production. In order to prevent the occurrence and transmission diseases in animal husbandry, Vietnam has issued a common charter for animal husbandry production that introduces regulations and treatment methods for a clean and safe production. However, the sanitation, vaccination and diseases control for animal greatly depends on farmer's own consciousness, but these jobs only attract the attention of large farms. Normally, small farms and farmer households do not pay much attention on these jobs that might cause a transmission of diseases continuously. Moreover, some diseases are also transmitted from animal to human that poses a great threat to human life. Therefore, a regulation to separate animal husbandry from human's residence is necessary. However, due to the limited land resource, high population density, the traditional habits of small farmers which have been carried out for thousand years, as well as financial investment constraints, this regulation has not been fully implemented. Livestock and poultry production in small farm size is still considered as an additional income of household farmers.

Recently, the development of aquaculture has been recognised and seen as an effective investment. Aquaculture developments are not only small-scale schemes but are also large intensive productive concerns. Many innovations regarding new breeds, and food use new sanitation and hygiene methods. Many models of combining aquaculture and paddy rice cultivation, for example the model of intensive fishery, intensive shrimp production, or

crab production, exploit the advantage of tropical agriculture. These are common in-water surface areas, and are widely available along the coastal region of Vietnam.

In general, the results from the process of transferring and applying innovations to agricultural production in Vietnam can be summarised as follows:

Product's productivity, economic efficiency has been multiplied many times.

According to research conducted by Nguyen (2011), the productivity of paddy rice in Vietnam has increased gradually from 1.2-1.4 tons/ha in 1878-1955; 2.0-2.8 tons/ha in 1960-1985; 3.5-4.05 tons/ha in 1990-1999 and 4-5 tons/ha in 2000-2010. So the time it takes for an increase of one ton per hectare is 30 years previously it took 15 years, and currently this has been reduced to 10 years. The national statistical data (yearbook 2010) has also recorded that paddy rice's productivity in 2000 was 4.24 tons/ha, and in 2005 was 4.86 ton/ha, and in 2010 was 5.32 tons/ha. The international conference on "Current situation and solutions for a sustainable development of hybrid paddy rice and agricultural ecology" was held on Hanoi 2011 has confirmed that the productivity of hybrid paddy rice is 15-20% higher than traditional ones. Total areas of hybrid paddy rice nowadays is approximately 600,000 hectares with the productivity of 6-6.3 tons/ha (Nguyen, 2007).

According to the Department of Information, the Vietnam Academy of Agricultural Sciences, the productivity of maize has been increased from one ton/ha (1961), 1.55 tons/ha (1990); 2.11 tons/ha (2000); 2.75 tons/ha (2005) and 4,30 tons/ha (2009); the productivity of vegetable has also increased from 126 tons/ha (1999) to 151.8 tons/ha (2005)[18]. Productivity of animal husbandry has also increased focusing on crossbred pigs, milk cows, poultry and other special animals. The increase of productivity led to the increase of income per hectare and enhanced the efficiency of capital and labour using in agriculture. An objective of striving 50 millions VND per hectare/a year is feasible[19], and in some intensive agricultural areas, the income reaches to 150-200 millions VND per hectare/a year.

Diversifying a wide range of high quality agricultural products

In a new production, many high-quality rice, vegetables and fruits have been developed, lean pigs and milk cows have become the main animals on livestock, farms or many specialties in livestock and aquaculture have emerged. The available of improvements in

[18] http://w.w.w.rauquavietnam.vn/default.aspx?tabID=2&ID=24&LangID=1=NewsID=337
[19] For that situation, total expenditure is estimated around 19 million VND

seed and breed technology provides a chance to produce new products at favorable of the year, and allows consumers to diversify their options. Previously, only during the Tet festival or on other particular times during the year, householders may consume perfume rice and other high-quality agricultural products such as pork or shrimp and fish. Currently, high quality agricultural products are being consumed more regularly. The low-quality products are gradually disappearing from the staple diets of Vietnamese. Most of the products, which are exported, have been developed from the typical agricultural products of Vietnamese's agriculture.

The development of science and technology has also provided a chance for regional specialties to become more widely available in surrounding areas. In addition, indigenous knowledge might be collected and combined with modern knowledge to create a new efficiently production. The border of specific fields is not so important in terms of ecology or geography. As mentioned in the section above, the gap between specific fields or geography would be narrowed by the application of innovations. In addition, the development of transportation provides a chance for agricultural products reaching to their consumers in far away regions, or customers might purchase a product that does not come from their regions. Currently, agricultural products such as perfume rice, sticky rice, litchi, longan, mango, dragon fruit, pomelo, orange, grape, custard apple, kaki, rowan, mangosteen, durian, rambutan, coconut, mountainous goat, local chicken, local duck, suckling pigs, crayfish and many other special aquaculture's products, are very popular within Vietnam and are easily distributed to their consumers.

Developing agricultural machinery

Since 1960s, small machinery was used in Vietnam. In cultivation, machinery has helped farmers with irrigation work, land preparation, transportation and more recently harvesting and processing. In livestock, machinery has helped farmers in food processing, transportation and sanitation. Mechanisation in agricultural production has enhanced the efficiency of labor, moving away from the old style of operating agricultural production. Through the works of preparations as planning and schedule design, technical preparation for the machine, profit and loss calculations, farmers are gradually becoming more familiar with new procedures of a modern production.

Currently, approximately one million of young labors leave the agricultural sector every year (Dao, 2000), but all agricultural work is still completed in time for production, and the

output is still increasing constantly. Therefore, mechanisation in agriculture is more important when rural labour is older and there are more women farming (due to men leaving rural areas).

Enhancing agricultural infrastructure

The application of new technologies requires certain types of conditions in terms of infrastructure, i.e. irrigation condition, transportation, temperature controllable, training services, and information channels for markets. Infrastructure might support for the application process of innovation, and in conversely implementing innovation such as the application of technology may support the development of infrastructure. For instance, by improving the community access roads, it is anticipated that farmers' travel time to markets and other social services such as hospitals and schools, will be reduced. Furthermore, it is expected that volume of trade will increase and stimulate different commercial activities to the benefit of different areas, which will in turn lead to better prices of farm products. I will also facilitate access to farm inputs and services, ultimately leading to increase agricultural productivity and positive impact on food security. Vietnam has heavily invested in rural infrastructure, for example, irrigation systems; interior transportation, agricultural credits, training services, rural electricity and health care in the rural areas.

Restructuring the agriculture towards greater efficiency

Rational economic structure might support actively the sustainable development of the economic entities. Economic structure can be split into three main types; structure by economic sectors, structure by regions or structure by economic entities. The process of restructuring the economic structure is assisted by the application of S&T. S&T changes the efficiency of production of sectors, or changes the way in which resources are utilised and also causes a change in the flow of invested resources. Therefore, due to the impact of resources reallocation, the economic structure of sectors would be changed. In agriculture, the economic restructuring process has come about by the reallocation of resources such as capital, land, labor, information, among cultivation and livestock, in which the factor of applying innovations for example new seeds/breeds, new support facilities, plays an important role. Or following to the application of innovations towards a creation of material zone, a structure by region structure changes. Alternatively, the process of restructuring the agriculture by economic entities is led by the appearance of new models where science and technology support for the efficiency of the farming jobs.

The Resolution of Vietnam Communist Party Nr. 5-NQTW, session VII, 1993 has settled a green light for economic restructuring processes to go ahead. Since then, many resources have been allocated in a better way. Land, labour and capital is now utilised efficiently not just for agriculture but also for other fields such as handicraft, trade services; as well as for cultivation, livestock and aquaculture, paddy rice and for other crops.

The specialized production areas are formalized

Historically, in Vietnam, there are many specialised geographical zones, where traditional agricultural products have been produced for a long time. The name of the products always reflects where the items comes from, i.e. Tan Cuong tea is produced in Dai Tu district, Thainguyen province, or coffee comes from High Land. Further to this, Thanh Ha litchi comes from Thanh Ha district, Haiduong province; Tien Lu longan comes from Tien Lu district, Hungyen province; Lam Son sugarcane comes from Thanhhoa province; Quang Ngai sugarcane comes from Quangngai province,

Currently, the availability of processing technologies, convenient transportation, or support of applying innovations in agricultural production as fertiliser and pesticide and avoiding risky techniques provide a chance for farmers to sell their products to consumers in other regions far away. Therefore, many traditional regions have expanded their production. In addition, by applying innovations in seeds/breeds technologies, many traditional varieties and livestock have been immigrated to other equivalent regions, i.e. litchi has been immigrated from Haiduong province to Bacgiang province. So there are many large zones have been found focusing on production of commodities. The creation of specialised areas focuses on two main objectives:

(1) Provide materials for industrial production such as the sugarcane coffee tea, rubber, and aquaculture's product processing industries, or

(2) Lead to the change of economic structuring in the region, creating areas for certain types of products, i.e. for vegetable, fruit tree and shrimp production.

To meet the requirements of production, new varieties and technical processes have been studied and applied in each eco-region. The new issue has emerged that the specialization of a region is becoming increasingly clear, the product from the region becomes higher nature of goods, resources are focused on producing specialised products. At locality, resources are allocated according to their specialization for each sub-region.

The natural resources are exploited more for production

In addition to the natural resources that are being widely used to apply new science and technology, natural resources, especially land (low land, alluvial soil, coastal plain, hilly soil, forest land...), and forest resources have been exploited using the following methods:

(1) Agro-forestry in mountainous areas,

(2) Combination between cultivation and livestock with appropriate farming techniques,

(3) Reserving forestry along the coast to protect agriculture from disaster as sand encroachment, waves

(4) Developing aquaculture on coastal land and low lands,

(5) Applying efficient models for favorable regions, and

(6) Developing eco-tourism

2.3.3. Conflicts emerging from development

In addition to the achievements, development has raised many problems, and revealed difficulties that require a more broad application of science and technology:

2.3.3.1. Conflict between planning short-term needs and long-term development

Theoretically, short-term objectives should conform with long term aims. However, in reality this is not easy, and many difficulties and problems have emerged that require immediate solutions. For example forward planning has not been carried out effectively, as producers just invest and pay their attention for a profit in a short term, and long term the objectives have been ignored. For instance, the use of pesticide to disseminate the risk of damage caused by harmful insects also results in killing good natural enemies. Therefore, during the next cycle when natural enemies are no longer present, harmful insects may return freely and quickly, causing a more damage to products. Another example is the use of additives to push the growing rate of vegetables. However even the utilisation of these additives may cause harm to consumers, but focused on profit, the growers do not heed warnings, and they produce unsafe products just for money. In this situation, there appears to be a lack of control from the authorities, or that farmers are not educated well to recognise the risk they may be bringing to their customers.

Therefore, there is a need to develop a safe and sustainable agriculture, in which applying S&T would provide solutions to deal with these difficulties. As such, innovations have not

only been applied in production but also in managing, in controlling, in evaluating and monitoring that provide a fair trade to all involved parties.

2.3.3.2. Conflict between expectation and real application

In a modern agriculture, in order to achieve good results, all of procedures should be implemented strictly, however the application of innovations depends much on (1) the introduction and guideline of extension services' agent, (2) capability of getting knowledge of farmers; and (3) the expectation and obeying of farmers as users to apply new techniques.

If one of three above conditions are not satisfied, then the application of innovation could result in failure. For instance, in some cases, the demand from farmers is not met by guidelines from extension agent because the introduced innovations are not specified for them. Alternatively, as a result of farmers low capacity to recognise technical issues, together with the characteristics of farmers (where they want to conduct experiments in their own way), many innovations could not come to life. For instance, research conducted by Pham (Van Dinh) and colleagues (Pham et al., 2011) reveals that farmers in Haiphong province do not need to learn new techniques to produce paddy rice because paddy rice is cultivated has been carried out by numerous generations for thousands of years.

Therefore, there is a need to localise knowledge before introducing it to farmers, or provide options for farmers to get technical information, vocational training. Enhancing the monitoring system and co-operation between farmers and partners, or founding a new way of implementing agricultural production by contracts would also help solve these difficulties.

2.3.3.3. Conflict between demand for applying innovations and limited financial resources

Many researcher have indicated that the ability of Vietnamese farming households to save is limited (Pham et al., 2011). In a year, a household farmer might save only 5-8 million VND, and they have many difficulties regarding expenditures which need to be made in daily life. With reference to applying innovations, investments in new seed (which normally cost more than traditional ones), fertilisers, pesticides in cultivation, or breeding, animal's food, animal housing and in livestock need to be made. Due to the limited in financial capital available, many farmers' households prepare seed or breed by themselves

in the traditional way, or they cannot fully invest in buying new fertilisers or not carrying out pest control as recommended in the guideline.

As a result, there is a need to provide flexible credit to farmers, enhancing the effectiveness of agricultural and rural development banks, or to develop co-operation between enterprises and farmers as well as using other forms of financial support for agricultural production.

2.3.3.4. Conflict between mechanization and unemployment in rural areas

The mechanisation of agricultural production has freed up labour in the rural areas, especially for heavy jobs such as land preparation and harvesting. However, a large number of labourers in Vietnam reside in rural areas, and are therefore affected by the introduction of mechanics and urbanisation. As such, unemployment becomes an increasing problem in the region.

The labour in the rural areas is also mainly made up of old farmers or women, therefore in this situation, it makes sense to use machinery for heavy jobs. However, as result of low-income and limited capital, machines are only hired in unavoidable cases. In addition, old farmers are generally conservative, hesitate and slow which constrain the application of innovations as well as gaining success. Further to this, women farmers are seen as inferior within their family as well as in society as a result they do not actively get involved in applying innovations.

Therefore, in order to support the application of machinery in agricultural production, other jobs in the rural communities should be created to solve the problem of an abundance of labourers. In addition vocational training programs should set up to re-train farmers how to use new mechanical techniques and informing them about the development of machinery is also needed.

2.3.3.5. Social conflict in rural areas when losing agricultural land to other purposes

The conversion of some agricultural land to non-agricultural purposes is an objective requirement in the process of industrialisation and urbanisation. However, conflicts among farmers whose land has been retrieved, for instance, these farmers are getting difficulties in finding a new job in their new residence is likely.

In reality, according to national statistical data, although the efficiency in the use of agricultural land has been increased, the amount of land available for growing paddy rice

area is decreasing (7666.5 thousand hectares in 2000 decreases to 7513.7 thousand hectares in 2010). The decrease is caused by (1) retrieved land is mainly paddy rice areas, or (2) the appearance of new models for fruits, aquaculture or livestock retrieve land reserving for paddy rice.

Therefore, there is a need to provide a common solution, from vocational training to enhancing the ability of local authority to manage land, or help create other jobs to attract farmers whose land has been retrieved to participate in the process.

2.3.3.6. Conflict between demand for exploiting natural resources and environmental conservation

In recent years, the natural resources of Vietnam have been warned to be exhausted due to rapid exploitation without recovering effort. The need of exploiting natural resources for development has caused environmental degradation. The loss of forests and degradation in natural resources has consequently caused many disasters and threatened human's life.

According to UNEP-RRCAP (2001), in 1980 the total area of natural broad-leaf forest in Vietnam was 617.2 thousands hectares, but in 1998 this number is only 221.4 thousand hectares, respectively the number for natural deciduous forest is 1202 and 632.8 thousand hectares; and for mangrove forest is 34.2 and 2.3 thousand hectares. According to Forest Inventory and Planning Institute, during the 20 years (1975-1995), the total amount natural forest has decreased by 2.8 millions hectares. The fire forest in 2005 was 6829.3 thousands hectares, however in 2010 it had fallen to 6723.3 thousand hectares. The amount of exploited forest in 2005 was 3347 thousand hectares, and in 2010 is 1057.4 thousand hectares.

One of the main reasons causing the degradation of soil's quality and environmental pollution is overuse of chemical fertilisers and pesticides. Nguyen (2011) and colleagues pointed out in their study (2011) that farmers usually utilise 22 kgs of extra chemical fertiliser per hectare that is not required. The Ministry of Agriculture and Rural Development has also warned the overuse of chemical pesticides has increased from 10,000 tons per year in 1980 to 30,000 tons per year in 2000. Besides this, the pollution in handicraft villages is becoming a really significant problem. The unbalance of the eco-system is popular or the rapid growing of intensive aquaculture has caused to unbalance of ecology in the region.

Theoretically, the main reasons are:

The mechanism of market economy has not been recognised widely in agriculture and rural areas. In addition, there is a lack of mechanisms, which promote farmers actively solving their problems themselves, especially in the remote areas. The mechanism of previous command economy and subsidy regime severely affected the implementation of socio-economic programs in Vietnam. Sometimes constraining the operation of the economy by subjective interference, subjective voluntarism without focusing attention on the real situation. In addition, farmers are also looking for subsidies from outside and do not want to buy or to learn new techniques or new knowledge.

The limitation in designing a general plan and providing a guideline for implementing macroeconomic policies has constrained the development of the economy in the long-term as well as in the short term. Some policies also overlap and contradict each other. Further to this, sometimes the local authorities do not understand or grasp the spirit of the policy, causing in reality the incorrect implementation process to be used.

State-owned enterprises are still do not command much power and the infrastructure is underdeveloped. There are also problems with limited investment for agriculture and rural areas, insufficient budgets for agricultural research as well as other socio-economic programs in the rural areas and; the system of extension service is still weak.

How much farmers understanding and recognise innovations, and the applying innovations in their production is unclear. In addition, farmers are used to work arbitrarily in a self-sufficient economy that makes the realisation of the provisions superficially. Consequently, policies are being issued; and programs are being implemented, but farmers set themselves out of the impact and consider that is the mission of others, not for them.

In summary of the chapter, the growing influence of science and technology has greatly impacted on many aspects of socio-economic life. The role of S&T in development has been widely recognised. However, the application of science and technology in real life has revealed many problems and conflicts, which need to be solved to achieve better results. In order to promote the efficiency of applying S&T in economy, S&T should be considered within a context of Vietnam's economy. Therefore, it is necessary to find root causes as well as immediate problems which are affecting the development of the economy, and then choosing appropriate technologies as well as reasonable methods to transfer or apply science and technology in practice. After each small topic, I have already

inserted some comments derived from trend of analysis. I would not gather all these comments in this part, but only focus on issues that would be core issues for next writings. Regarded issues and the approach in this chapter would be backbone and core issues for analysis in next chapters, especially for empirical research. From theoretical research, the core findings are as follows:

- Innovative advancement covers a wide spectrum of technical issues to advancement in management or skills of farming. The transfer of such innovative advancements has significantly developed with particular emphasis on the active participation of recipients and the linkage between actors or environment for establishing such relation.
- In a market economy, many conflicts have emerged that require an efficient interference of management from macro as well as micro perspective. The support from management relates to not only support for the development of each actors' capacity, but also creating a favorable environment for the development of linkages among them base on market mechanism.
- Models of transferring innovative advancements to farmers based on linear approaches such as "push" and "down" are being replaced gradually with models focused on an interdisciplinary approach, where the linkage between actors is a more important dynamic than capability of R&D. The transfer of innovative advancements does not only emphasis on what would be transferred but also on the ways in which farmers can access innovation.

3. METHODOLOGY AND RESEARCH DESIGN

3.1. Methods

3.1.1. Conceptual framework

Research on the process of transferring S&T's achievements to farmers examines two main activities: (1) the transfer of innovations and (2) activities of applying innovations in agriculture for profit and selling products in the market. The approach deals explicitly with knowledge creation, assimilation and transform, distribution, utilization, dissemination, occupying market as the key component of analysis, in which three main groups of actors would be involved, including the creators of invention and knowledge for transfer, the intermediaries supporting for the process of transferring/applying, and the last group of farmers as receivers/end users.

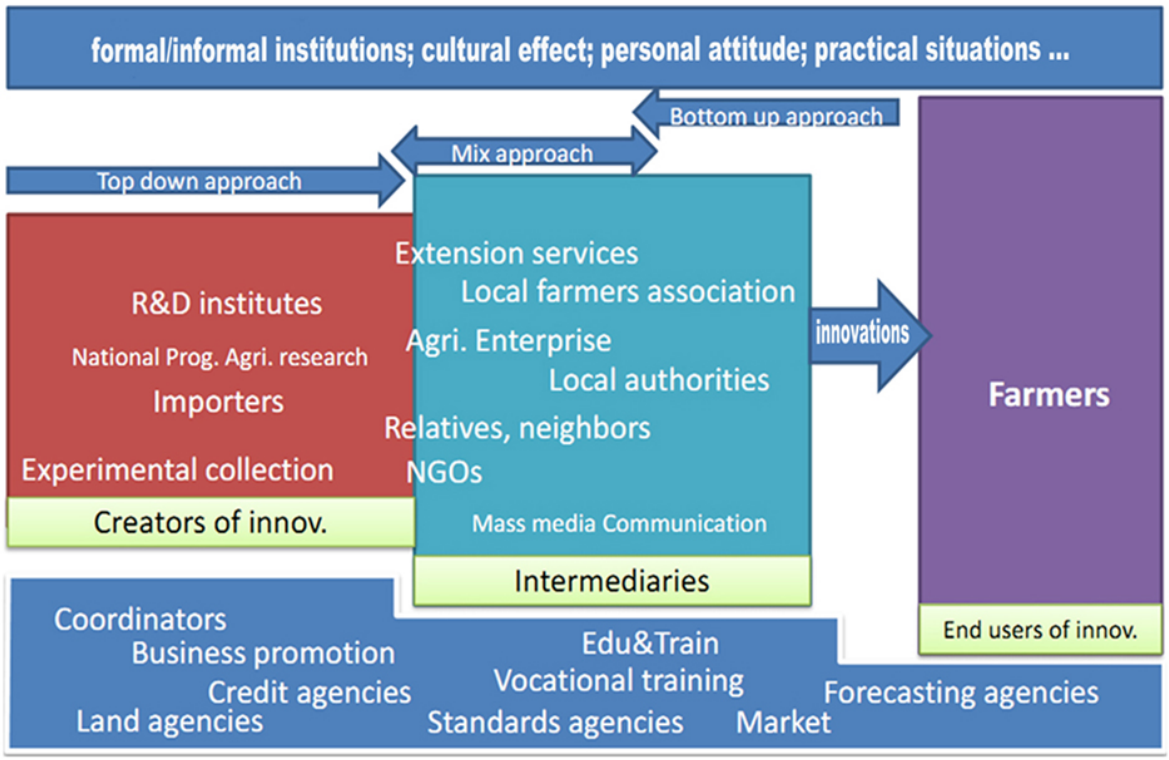


Figure 3.1: Conceptual Framework of the study

Source: Own compilation

In addition to this, other organizations play diverse roles, as supporters for enhancing the capability of involved partners, or accelerating the linkage between actors. Furthermore, they create an equivalent environment for co-ordination, or provide incentives for applying innovations. Such types of inter-organizational knowledge links and knowledge transfer

facilitating operation happen under the co-ordination of formal or informal institutions, cultural effect, personal attitude, practical situations and so on. These issues can be seen from top-down, bottom-up, mix-trends that connect very closely with five models of transferring innovations to farmers. Adapting from the analysis in value-chain approach, the study examines the actors involving in the process, their linkages and take farmers' acceptance is a key indicator to evaluate the effectiveness in operation of these actors. In addition, adapting from analysis of the innovation system approaches, the study also examines not only the innovative actors but also a system of interactions and interdependencies between those actors and institutions.

The study contains two main stages, pre-empirical stage and empirical stage. After a theoretical review and analysis on critical issues, the study will conduct empirical research to examine the actual situation according to given research design. In the empirical part of this research, ideas from farmers will be collected regarding their evaluation on designed topic and through the analysis on these evaluation, findings would be derived to reveal the actual situation of the research region, as well as the basis for recommendations and solution as the final stage of the study.

3.1.2. Research design

In order to conduct this research, a literature review, two surveys, and a lot of work have been done through steps. The issues described in figure 3.2 below will be the best systemic adaptation to the performed workload.

In the first stage, before setting initial design and questions of research, a flash review has been conducted to ensure that the research topic would not be duplicated by anyone else. After the very first stage, an initial design was analysed, in parallel with examining the background context, defining the problem and the boundaries of the research and literature review. The result of this step was a draft structure of research and a set of questions for research, including general research question and concrete research questions.

In the next step, after a theoretical research by collecting and analysing literature, the study tries to create a research design. One thing is noteworthy that from this step until the step of analyzing data, a mutual interaction/reconsideration/ comparison for suitable in between later steps with previous steps has been done to get the best fit result.

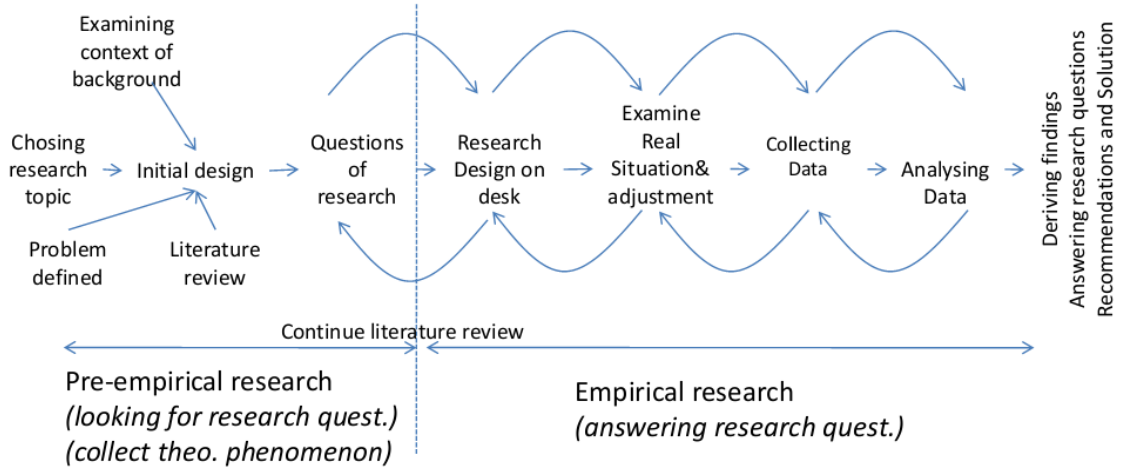


Figure 3.2: Simplified model of research process

Source. Adapting to Punch, 2005, p.40.

Especially, in between step of design on desk and step of examining real situation and adjustment, the study has to apply many techniques such as testing the suitability of questionnaires, or consulting experts for suitable information.

In the step of collecting data, adjustment relating to questionnaires and number of interviewees are also adjusted to reflect the best result. For instance, in the process of data collection, in some locality, when the evaluation of farmers becomes duplication and there are no new issues appear, the survey would stop at this point and change to other locality. That is why the number of interviewees is different in three provinces.

Return to the step of designing research on desk, in order to design questionnaire, the principle of the survey has been clarified, in order to conduct a semi-structured survey. In addition, the study has relied on assumptions, in appropriation with theoretical issues, to define a set of questions (Table 3.1).

Similarly, there are also other preparations like above arrangement for doing the survey and analysis. These preparations would be attached in the appendix, including two samples of questionnaires, one for farmers and the other for intermediaries and creators of innovation.

Table 3.1. Sample of the framework for questionnaire design for farmers

I. Evaluating the influences of indigenous factors on the process of transferring innovations to farmers ***Assumption: the personal characteristics of farmers would impact on the process of applying innovation in agriculture. These characteristics may encourage or dis-encourage the process:***	
1. The impact of ages and labor:	More young and wealth then intend to apply innovation, precisely
2. The impact of sex	The relation of sex and application of innovations, may be extension agents should consider the process of approaching to farmers via a group of women or…
3. The impact of level of education of the head of household	May be more educated then precisely they have more capability in applying innovations
4. The impact of economic wealth status: square of land possession; machinery equipment, available of capital?	Whether, more land possession then are more capable for applying innovation
	Whether, more wealth in finance then they intend to invest for innovations
	Whether, the relation between equipped machinery and capability for innovations is existed
5. The impact of culture as local behavior, local habits	Whether, the process of transferring innovations to farmer should concern about the appropriation of innovation in local culture
II. Evaluating the influences of exogenous factors-external factors on the process of transferring innovations to farmer households	
1. Evaluate the interest of farmers on applying new innovations in agricultural evaluate the awareness of farmers of improving their agricultural production	Have you ever heard about application of S&T advancement in agriculture
	If yes, Which innovations have you ever applied in your work, please tell me your story of applying an innovation in agriculture
	(an open conversation)
	- Asking the beginning time of application
	- Asking the name of innovations
	- Asking the social context and reason for application of innovation, the situation of neighbor farmers, market and so on
	- Capability in calling finance for innovation application
	- Capability in receiving and mastering new techniques
	- Advantages/Difficulties in the process of innovation application
	- The result of the process
	- The willingness and other suppose
2. Evaluate the available of sources of S&T advancement/methods of getting new information about new innovations in agriculture: ***Assumption: In fact, information about innovations in agriculture is available but still far from the demand of farmers. The reason might be less awareness of farmers of innovations as well as there are some constraints of ability in approaching the innovations***	The available of programmes on radio, television, newspapers... talking about new agricultural innovations; and interest of farmers of reading them.
	The available of contact to extension agents; friends & other members of the family; university, R&D institutes, agricultural enterprises, local authority, by which farmers can get information regarding their needs on applying new innovation in agriculture
	Difficulties in getting contact with, or follow to the introduction of getting contact to above sources: Reasons and Why?

3. The forms of approaching to farmers and farmers' exception of the suitable forms ***Assumption: There are many forms of approaching to farmers but the most successful model should be originated from the demand of them***	Evaluating the participation of farmers in each channel
	Evaluation of farmers about their satisfaction as they look for information regarding innovations (5 ranks: 5,4,3,2,1 from very good to very bad) - Public mass media, local media through channels: + Mass media + Interest club, local associations + Local authorities - Vocational trainings - Visiting and training, best practices - Consultation and services - following agreement with agricultural enterprises... Evaluation of farmers about the appropriation of the form of transferring innovation to farmers (5 ranks: 5,4,3,2,1 from very good to very bad)
	Evaluation of farmers about the appropriation of innovation in local conditions (5 ranks: 5,4,3,2,1 from very good to very bad)
	Evaluation of farmer about the diversity of forms of transferring innovation to farmers
	- How frequent do farmers get contact with agents (monthly or yearly, or seasonally)
	- Do the farmers see any effort of outsiders in encouraging the diffusion of innovation in the locality
	- Difficulties in keeping the contact with agents? Reason and Why?
4. Evaluating the influences of infrastructures on application of innovations	Transportation (1,2,3,4,5)
	Electricity (1,2,3,4,5)
	Irrigation system (1,2,3,4,5)
	Machinery supporting for seasonal preparation, harvesting, post harvesting, conservation (1,2,3,4,5)
	Education system and vocational training (1,2,3,4,5)
	Extension services and local associations (1,2,3,4,5)
5. Evaluating the consideration of farmers on competitiveness of products those are from application of innovations and others ***Assumption: Farmers in a modern agricultural production should know how to choose options that is best fitted to the expected profit in comparison with other products.***	Price
	Quality
	Difficulties in the process of farming
	Market
	...
6. Evaluating the ideas of farmers about supporting programmes for applying innovations in agriculture ***Assumption: Support for agricultural production as a whole and for applying innovation in agriculture as in particular is still needed nowadays***	Programmes on building model of best practices
	Programmes on credits
	Programmes on supporting for output market of agricultural products
	Supporting for providing inputs factors
	Supporting for mastering new techniques in production

3.2. Choosing of research region

I chose the Red River Delta for the study because the process of transferring and applying innovation in the region is considered as diverse in terms of forms, contents and degree of applying innovations at farmers household. Moreover, the region has witnessed many historical events and experienced significant changes through the period of the "green revolution". The region has also seen the establishment of agricultural co-operatives as well as their collapse or restructuring recently. Further to this, it has observed the appearance of new factors during the “doi moi” period, where farmers were affected by diverse influences in the decision-making process for applying innovations in their agricultural production or not. In addition, farmers in the region can be distinguished as being highly-skilled, having a rich experienced, as well as being familiar with agricultural production, and also very active in the process of applying innovations.

For an overall view of the region, I chose the three provinces of Thaibinh, Haiphong and Hungyen for the study due to their high representatives for the study area.

Samples in the survey were then randomly selected to demonstrate objectively in collecting primary data. There was not much variation in the number of samples taken from the three provinces in order to be compared between localities.

3.3. Response variables

Before going into empirical research of the process of transferring and applying innovations in agricultural production of farmers in the Red River Delta, the study provides an overall outline of economic development and agriculture of the delta. The system of indicators in this section will include statistical indicators from secondary data sources, for instance total areas, the value of each sector, productivity, and the output of agriculture.

In the empirical section of the process of transferring and applying innovations in agricultural production of farmers in the region, based on the hypothesis, the study will formulate a system of indicators for data collection including qualitative and quantitative data. Qualitative data will be put on the scale factor assessment and will be linked to quantitative data used in the analysis, in order to highlight trends and behavior of partners.

- In order to assess the "subjective factors" or "inner elements" that affect the application of innovations in households, the study assumes that the characteristics - "subjective factors" of farmers can affect the process of applying innovations. They can have a positive or a negative impact in the process of applying the

"innovation". Thus, the data will include statistics on the factors of age, gender, education level, training level, income structure, land resources, equipment for production and working capacity of households.

- In order to find out the real situation regarding the process of transferring and applying innovations in agricultural production to farmers in the region, the study will use a system of qualitative evaluation of issues. These include farmers' awareness about innovation, the degree of difficulty in the application of innovation, and an evaluation of the financial resources for investing in innovation. For example, asking about the period of application innovation in the household and the background and context of the decision-making process. In addition, the status of neighbors and the influence of the market, or the capability of farmers to invest in innovations. In addition, the type of funding available for these innovations; alternatively, their capability to receive and utilize innovations.
- In order to examine the influenced factors that affect the process of transferring and applying innovations, the study will utilise indicators to examine the existence of agricultural input market, the effect of agricultural extension service, market the agricultural outputs of households, the role of institutions and farmers' associations in the locality and local infrastructure. This section aims to prove the assumption that "in fact, there are many forms of organisation to approach farmers to transfer as well as to diffuse innovations to farmers; however, the most effective form should be derived from the actual needs of farmers". Alternatively, that "farmers in a modern agriculture must know to select optimum factors to get the best profit comparing to others".
- In order to clarify the sources of information on innovations that farmers can access, through qualitative indicators (regarding assessment of farmers as well as the actual operation of these sources), the study will analyse different sources of information. For example, television, radio, newspapers, the internet, extension organisations, local authorities, the agricultural enterprises, R&D institutes, friends-neighbors-relatives, and associations of farmers in locality. This will be done to clarify the assumption that: "in fact, the information about innovations is often available but not accessible to farmers. The reason behind this might be misunderstandings made by farmers about innovations, as well as the fact that they do not care intensely much about innovation. This could be due to limitations on

the capacity of households to access the innovations. These findings might lead to recommendations to help improve the performance of these sources of innovations' information.

3.4. Data collection

- Secondary data:

Secondary data will be collected from official sources such as books, magazines, the Statistical Yearbook of Vietnam, Reports of Ministry of Agriculture and Rural Development, and relevant articles referred to on the website.

With an approach of top-down, the study will analyse and synthesis information from secondary statistic data and experts' review to give general conclusions related to research issues.

With an approach through examining policies on encouraging the transfer and apply innovations at farmers' household, the study would show initial assessment on the implementation of these policies and provide recommendations regarding research issues.

- Primary data:

Primary data was collected through surveys with semi-structured questionnaires, including quantitative data and qualitative data.

Two different questionnaires were used, one for farmers and another for those individuals and institutions who are involved in transferring information. For farmers, who are directly involved in choosing innovations and applying them, based on the semi-structure questionnaires, the study has investigated the behavior of farmers, and the difficulties they face as well as causes of the stagnation in applying innovations to agricultural production. Since then, recommendations for encouraging the application of innovations in farmers' production have emerged.

Table 3.2. Number of farmers in the survey

Provinces	**Count**	**% of total**
Haiphong	34	40,0
Thaibinh	23	27,1
Hungyen	28	32,9
Total	**85**	**100**

Source. Own survey 2009.

Primary data was also collected by conducting expert' review regarding research issues.

A survey was conducted in 85 farmers households and 15 experts and institutes relating to transferring innovations to farmers in the region.

Table 3.3. Count of experts in the survey

Type of career	Count	% of total
Extension service	6	40,0
Local authorities	4	26,7
Scientist	3	20,0
Enterprise's staff	2	13,3
Total	**15**	**100**

Source. The own survey 2009.

3.5. Data analysis

In order to analyse the data from the survey, descriptive analysis will taken into account to examine secondary data and evaluating findings from empirical research. Methods of statistical analysis will be applied to analyse the primary data. A comparison of the results between (regional) groups differentiated on education level, age, gender, will be carried out. The results will generated from evaluating the farmers and individuals/institutions responses.

Secondary data should be rearranged before analysis to fit the analysis' requirement.

Primary data should be cleaned before entering to spreadsheet programs like Excel and SPSS.

The data have been analysed by spreadsheet programs to show processed data in descriptive tables, or cross tabulation.

4. RESEARCH REGION - THE RED RIVER DELTA

4.1. Natural conditions of the research region

The Red river delta (RRD) is an alluvial land accreted by two river systems of Red river and Thaibinh river. Following to current administrative allocation (2011), the delta combines provinces/cities as: Hanoi, Haiphong, Vinhphuc, Bacninh, Hungyen, Haiduong, Hanam, Namdinh, Thaibinh, Ninhbinh. The delta is located between the northern midlands and mountainous northwest of Vietnam. The Vietnamese have inhabited for thousands of years, created a unique plentiful culture and life closely to traditional paddy rice growing. The RRD has played a crucial role in socio-economic development of Vietnam.

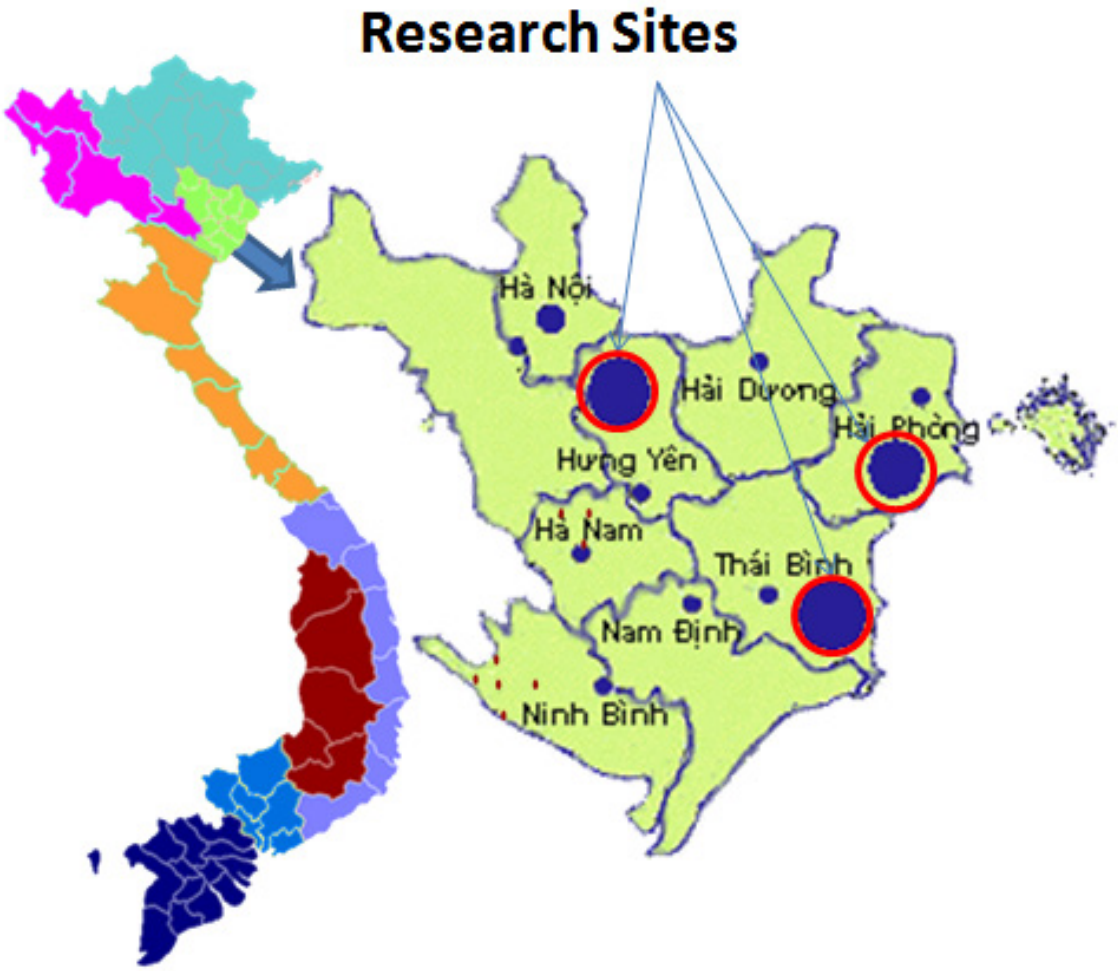


Figure 4.1: The Red River Delta

Source: extracted from national map.

Typographically/geographically, the delta is located in the northern tropics, extending from latitude 21°34' north to about 19°5' north, from 105°17' east to 107°7' east, its terrain is

relatively flat, 0.4-12m height over sea level. The total area is 14.862,5 square km, accounting for 4.49% of Vietnam, with a 400km long coastline and a vast territory of the sea which is valuable for development of marine economy. The northern and north-eastern part of the region is bordered by northeast Mountainous region. The western and south-western area is bordered by northwest Mountainous region, and Eastern are bordered by the Gulf of Tonkin and north central region. The topography is lower from the Northwest to Southeast, from 10-15 meters of ancient alluvial terraces down to the 2-4 meters of alluvial terraces in the centre and to daily flooding tide areas.

The northern coastal region comprises four provinces of Haiphong, Thaibinh, Namdinh and Ninhbinh, where there are many large estuaries which flow out to the sea, creating a favourable environment for development of aquaculture, fishing, and marine tourism.

Within the delta, there occur many low lands as large flood plains naturally as Hanam and Ninhbinh region, or Hungyen and Haiduong. On the other hand, the changes in river flow over the years have also created swamps and ponds. This has resulted in the low lying areas and swamps being located far from rivers or separated from rivers by man-made dikes, therefore although large sediment is transported by rivers in flooding season, it does not fill these hollows.

Soil in the delta has a high fertility, suitable for agricultural production. Over thousands of years, land in the region has been primarily exploited for paddy rice production. Currently, agricultural land accounts for about 76.096 square km (which is approximately 51.2%) of Vietnam. Out of this, 70% is fertile alluvial soil, very valuable for agricultural production. The remaining unused land that is capable of agricultural production is estimated around two thousand acres.

Sources of water for irrigation are taken mainly from two river systems of Red river and Thaibinh river. Both surface and groundwater is of acceptable quality. The average rainfall is 1400 - 2000mm annually and is unevenly distributed throughout the year, the dry season lasts from October - April, and the rainy season falls between May - September. In the rainy season, heavy rain and large amounts of water collecting upstream during a short period of time often causes widespread flooding downstream. Therefore, regulating water and developing irrigation systems to sustain stable water supplies, and to prevent loss of human life in the region from flooding is necessary. Concern has particularly been raised by of residents in the region. Currently, the development of hydro-power upstream in

combination with controlling water in downstream areas has had a positive effect on irrigation management in the region[20]. The climate in the region is tropical and subtropical monsoon, average temperatures range from 22.5 to 23.5°C annually, with the cold season lasting from October – April, while the hot season existing from May to September. Climatic conditions are favourable to diversifying plants and animal structure, allowing the migration of many plants and animals from other tropical and subtropical regions in the world. To exploit this advantage, the role of science and engineering is tremendously important.

River systems: There are a number of rivers and canals in the region such as Red River, Duong river, Luoc River, Day river, Hoang Long river, Namdinh river, Ninh Co river, Quan Lieu canal, Vac river, Yen Mo canal, Thai Binh river, Cau river, Kinh Thay river, Kinh Mon river, Kenh Khe river, Lai Vu river, Mao Khe river, Cau Xe river, Gua river, Mia river, Hoa river, Tra Ly river, Cam river, Lach Tray river, Phi Liet river, Van Uc river as well as hundreds of other small rivers. These rivers and canals are bordered by artificial dykes that serve mainly in the production of paddy rice.

The region has unique minerals; most notably is the lignite and there is estimated of 8.8 billion tons in the Delta as well as natural gas in Tien Hai, Thaibinh province. Other materials such as limestone used in construction are plentiful with potentially billions of tons in the region. In addition to the mineral resources for industrial production, other natural resources such as agricultural land and irrigation systems are key factors for agricultural production.

Cultivation is a crucial part of agricultural production. In the Red River delta the main crops grown are cereal food especially rice. Paddy rice is grown in two crops a year. In the upper land, many subordinate crops are grown (sweet potatoes, legumes, nuts), while besides the river bank, other crops such as corn, bananas, vegetables are cultivated. Industrial plants, fruit and vegetables are grown indigenously focussing by geographical

[20] A several tremendous hydroelectric factories have been constructed from 1960 up to now:
Thac Ba hydroelectric factory had been constructed from 1960 to 1975
Hoa Binh hydroelectric factory had been constructed from 1976 to 1994
Tuyen Quang hydroelectric factory had been constructed from 2002 to 2007
Son La hydroelectric factory has been constructed from 2003 to current
Several medium hydroelectric factories as Nam Ngan (Hagiang), Su Pan 2 - Nam Toong, Nam Khanh (Laocai) have been constructed from 2005 up to now
Source:
http://songda9.com/index.php?option=com_content&view=article&id=176:congtrinhtrongdiem&catid=39:congtrinhtrongdiem&Itemid=381&lang=en

location such as longan (Tien Lu belonged to Hungyen); litchi (Thanh Ha belonged to Haiduong); orange (Van Giang belonged to Hungyen); tangerine (Tich Giang belonged to Hanoi); pineapple (Dong Giao belonged to Ninhbinh); guava (Dong Du belonged to Hanoi); sugar cane (Van Diem belonged to Hanoi and Hung Ha belonged to Thaibinh); sedge (Kim Son belonged to Ninhbinh and Hung Ha belonged to Thaibinh); grow nut (Tam Dao belonged to Vinhphuc, Thuan Thanh belonged to Bacninh); pharmaceuticals (Khoai Chau and Van Giang belonged to Hungyen); flowers, decorative and bonsai plants (Tu Liem belonged to Hanoi; Van Giang belonged to Hungyen and Me Linh belonged to Vinhphuc); vegetables (Haiduong); corn, bananas and vegetables at the river bank.

In comparison to cultivation, livestock production has been seen as of minor importance within the field of agriculture. Despite there being the right conditions available for rearing livestock, it is always dependent on cultivation. Domestic animals are mainly ploughing buffaloes, pigs, chickens, ducks, geese, cows, fishes and shrimps. There have been many traditional regions for specific livestock for generations such as Namdinh for I pigs, Bavi and Phudong (Hanoi) for dairy, Vandinh (Hanoi) for duck, Thanhtri (Hanoi) for fish. These products have a distinct taste based on the origins of production.

4.2. Socio-economic characteristics

Infrastructure in the region is relatively developed, including transportation, electricity, health care, water, education.

Regarding transportation, the region has developed many modern roads such as: national highway 1A through Vietnam, the highway Gie-bridge to Ninhbinh, the highway Nr.5 linking Hanoi - Hungyen - Haiduong - Haiphong, the highway Nr.10 connecting Ninhbinh - Namdinh - Thaibinh - Haiphong - Quangninh, the highway Nr.18 linking Hanoi - Bacninh - Haiduong, the highway Nr. 18 connecting Bacninh to Hanam, Haiduong, the highway Nr.38B connecting Haiduong to Ninhbinh, the highway Nr. 21 connecting Hanam to Namdinh, and other highways as Nr. 2, 3, 6, 32, and others.

In addition, roads have been extended to centres of villages and there has also been investment in the railway networks for example the line connecting the north and the south, Hanoi and Haiphong, as well as Hanoi and Northern Mountainous Region. Besides this, there are three airports within the region such as Noibai international airport, Catbi airport, Gialam airport in the region. Finally, there are also many ports for import/export in

Hanoi, Haiphong, Cai Lan, Diem Dien (Thaibinh) who supports economic exchanges between the region and other partners.

The RRD has a consistent infrastructure and facilitation. Apart from regional roads connecting to other regions, rural transport systems and water-use systems (irrigation system) within the field are well developed. Recently, as a result of policy guidelines calling for co-operation between the state and the civil population with regards to constructing rural infrastructures, electricity has been extended to farmers' houses. Further to this, most rural roads have been concreted and schools and health care centres have been built in each commune. This development has created favourable conditions for production and livelihoods of farmers in the region.

The region has a relative advantage in transferring innovations to farmers due to the location of a number of cities within the regions. As such Hanoi, the capital of Vietnam is the centre of politics, science, economy and culture. In addition Haiphong is a leading seaport, and there are also many other cities where universities, research and development institutes, training and technique transfer organisations are based. The regional power system is considered to be best in comparison to other regions in the country. The Pha Lai Thermal Power Joint-Stock Company has integrated to the national network of electricity suppliers and the national electric network has been extended to the farmers' entire household in the region. This provides a chance for farmers to apply modern machines in the production, or to serve their daily electricity consumption demands.

Health care in the region is quite well developed as all communities in the region have a health care centre. Hospitals are also available within districts and provinces. There are also a number of tremendous prestigious hospitals equipped with modern facilitation, high-skill staffs in Hanoi.

In agriculture, infrastructure and facilitation are increasingly completed including irrigation systems, crop protection stations, processing enterprises, which are favourable environment for application of advancement in agricultural S&T in the region.

RRD is one of the main culture centres of Vietnam. Over generations, a unique culture, life's style, and behaviour has been developed and resulted in inhabitants having particular characteristics. For instance, the unique cultural identities in the regions are ancestor worship, divine worship in Lunar New Year festival, Nguyen Tieu festival (in 15 January in the Lunar Calendar), Mid-Autumn festival, or other folk art-forms as Bacninh folk

(Quan ho), traditional operetta (Cheo) in Thaibinh, Namdinh; Huong Pagoda`s festival, Thay Pagoda`s festival, Tay Phuong Pagoda`s festival, Tran Quoc Temple`s festival, Lim`s festival, Giong's festival, Chu Dong Tu`s festival (Hungyen); Phu Giay's festival (Namdinh), Keo pagoda`s festival, Tran Temple`s festival (Namdinh), and thousands of village festivals are held in January (lunar calendar) annually in different localities within the region.

There are also many well known places for natural tourism in the region such as Do Son beach, Cat Ba Island (Haiphong), Dong Chau beach (Thaibinh); beach Quat Lam, Hai Thinh (Namdinh), Cuc Phuong forest, Kenh Ga mineral springs, Tam Coc - Bich Dong (Ninhbinh), and many others. Further to this there are a number of spiritual tourist destinations for example the Huong Pagoda, Tay Phuong Pagoda, Thay Pagoda, Tran Quoc Temple, Phu Tay Ho Temple, Bai Dinh pagoda (Ninhbinh) and Keo pagoda (Thaibinh). Historic tourist sites also include the famous temples of King Dinh and king Le, the church of Phat Diem (Ninhbinh), Tran temple (Thaibinh) and the Kiep Bac temple (Haiduong). There are also thousands of other smaller attractions including new developments built in Hanoi and other localities.

The development of many handicrafts within the RRD has also been longstanding and there are a number, which are indicative of the region such as Battrang ceramics, Kieuky leather, Vanphuc silk, Phuxuyen rattan and Chuong bamboo hats (Hanoi) as well as Dong Ky carpentry, pearl mosaic in Dinh Bang, Dai Bai bronze and Phong Khe paper. There are also others such as the Da Hoi iron (Bacninh), Dong Sam silver carving, Hung Nhan bamboo (Thaibinh), Kim Son sedge (Ninhbinh). In addition there are many other famous agricultural processing products such as wine, sorghum, cereal, green beans cake, Gai cake, as well as Khuc cake, Chung cake, Day cake and bride cake.

Due to the natural conditions of the region as well as spiritual characteristics of inhabitants, there are many advantages and disadvantages, which therefore affect the process of transferring and applying S&T's achievements in agricultural production of farmer's households.

The advantages:

- The development of irrigation systems associated with the system of rivers is mainly the prerequisite for agriculture of paddy rice production

- Nature has given invaluable water resources to the region. In fact, by taking advantage of natural river and irrigation systems within a relatively complete network has been developed, providing enough water for agricultural production in the region during normal weather conditions.
- With its advantageous geographical location and relatively flat terrain, the region has very favourable conditions for economic exchange, cultural exchange, allowing farmers to receive new information quickly and to apply innovations in their production.
- Due to the advantages of suitable land, topography and climate, these resources can be exploited to develop a diverse agriculture.
- The economic structure within the region is favourable due to industry and services, to creating jobs for rural workers as well as mobilising idle capital from residents and allowing the utilisation of the land.
- The spiritual life has created a cultural background for residents in the region and strongly influenced the character and behaviour of residents including the way in which citizens behave during the process of transferring and applying S&T`s advancements in agricultural production and the promotion of the diffusion-effect of this activity.
- The presence of many R&D agencies/organisations throughout the region has helped farmers to find information about innovation, or the adoption of new techniques as well as where to look for help to improve their farming techniques.
- Alongside the development of infrastructure and the economic, the linkage between different economic entities has also been developed and regulated. Local institutional is developed to be appropriate with level of development of the region.

The disadvantages

- The effects of a tropical climate, natural disasters such as typhoons, widespread flooding and diseases, are always a threat to farmers crops and livestock.
- Every year rivers are filled with a large amount of silt from upstream flooding. In addition, the impact of hydroelectric dams to the flows of rivers has meant that it is difficult to retain water during the dry season and allow the proper drainage of water during floods.

- The high population density (1225 people in a km2 - 4.8 times more than the average population density of Vietnam) has put pressure on the exploitation and use of natural resources such as land, water and forests
- Agriculture in the region is typically labor-intensive and there has been investment in mechanical farming equipment resulting in low productivity and other difficulties for farmers.
- Although institutional and regulation is starting to maintain and adjust the cooperation between economic entities, in some operations/fields this is not being done effectively and a greater effort is required to generate favourable environment for local residents.
- The urbanisation of the area has taken up agricultural land and as a result had negative social impacts on residents

4.3. Initial results of agricultural production in the RRD

The RRD is one of two largest paddy rice producers in Vietnam, where historically the development of production is always associated with the development of socio-economic condition throughout the country. Agriculture in the region has changed since the 1960s firstly due to the development of the "five tons of paddy/ha" movement. In addition there have been considerable breakthroughs since the enactment of "reform" (doi moi) policy[21]. As a result, there has been continuous growth and diversification towards a more commodity-oriented agriculture. However, many critical issues have emerged through this development process and require solutions.

The next section will analyse the main development of agriculture in the region since 2000 focusing on 3 key areas of cultivation, animal husbandry and services.

Figure 4.2 shows that value of agricultural production (at constant 1994 prices) has increased continuously, especially during 2000 and 2008 (Table 4.1) for all sectors of agriculture and cultivation. During 2005 and 2009 this increased by approximately 5.6% and there was a 10% increase in livestock production. In this period, the growth rate of service sector was very slow (under 3%). In addition Figure 4.2 reveals that the development of cultivation makes up a large proportion of agricultural development in

[21] Since 1986

general. Despite this the potential resources for cultivation haven't been fully exploited. In addition to traditional farming models, other new farming models are developed unstable.

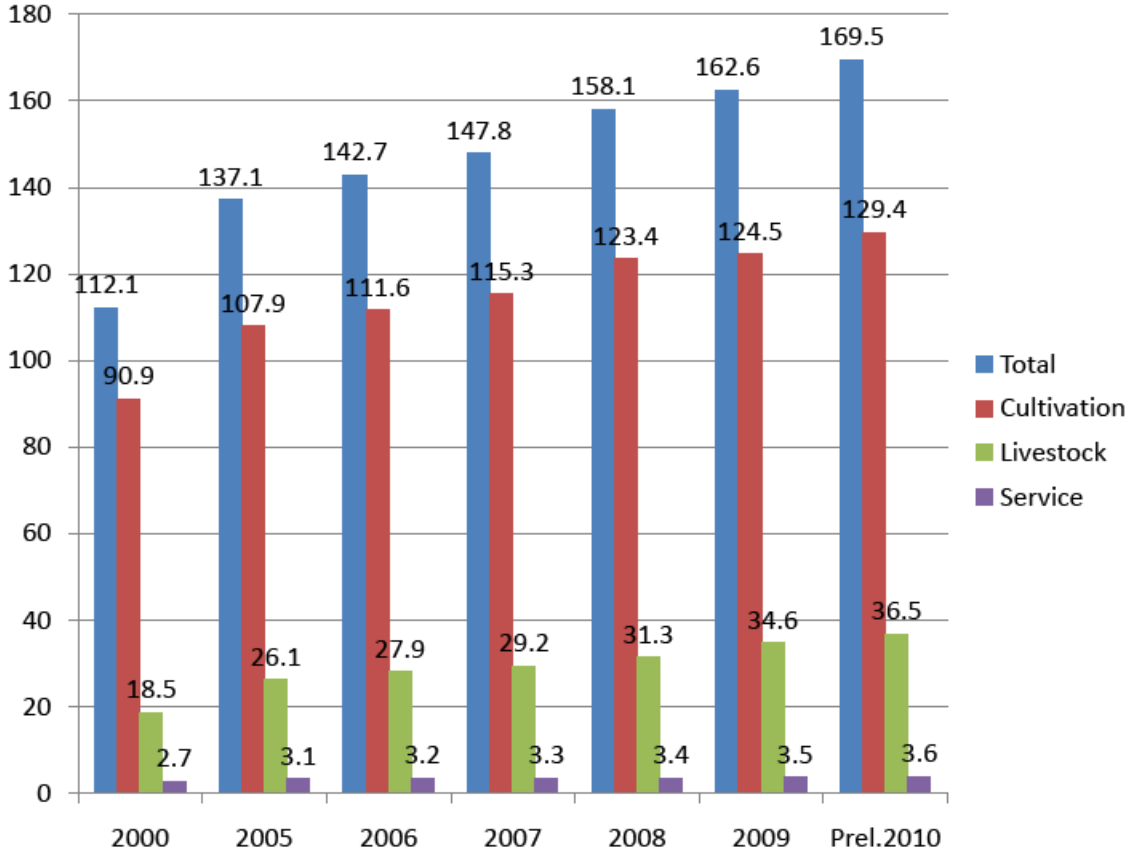


Figure 4.2: Gross output of agricultural production at constant 1994 price

Source: Calculated from statistical yearbook of Vietnam, 2010.

Despite a rapid growth of livestock production it has not significantly impacted the overall increase in agricultural production, for instance in 2005 and 2009, despite the livestock sector growing by 10% the total growth in agricultural production was only about 3%. Therefore, for over years and even in the renovation period, livestock is still not escaping out of vicious circle, considered as a dependent sector. Currently, livestock has been developed in a new model of intensive production in order to increase the volume of the livestock sector. However, a series of conflicts have been emerged as lacking investment for infrastructure, credit, sanitation, environmental pollution as well as human health issues such as livestock not being separated from people's houses.

Table 4.1. Gross output Index of agricultural activities at constant to 1994 prices

	Index (Previous year = 100) *(%)*			
	Total	Cultivation	Livestock	Service
2000	105.4	105.2	106.7	103.7
2005	103.2	101.4	111.4	102.6
2006	104.1	103.4	106.9	102.7
2007	103.6	103.4	104.6	102.7
2008	106.9	106.9	107.3	103.5
2009	102.8	100.9	110.5	103.3
Prel.2010	104.2	104.0	105.4	103.1

Source: Statistical yearbook of Vietnam, 2010.

The value of agricultural production (at current prices) has increased continuously (Figure 4.3), from 129.1 trillion (2000) (about 12 billion USD) to 430.2 trillion (2009) (approximately 20 billion USD) and preliminary figures from 2010 show that this has increased to 528.7 trillion, of which all three areas of cultivation, animal husbandry and services have grown. The structure of the different agricultural sectors has also changed. As such the proportion of livestock production is increasing whereas that of cultivation is decreasing, although this is not significant. It is also important to note that the share of the service sector is still too low (less 2% as shown in table 4.2).

These results indicate that in spite of increases in volume, Vietnam's agriculture is still stagnation. Despite this, the role of market mechanisms in the rural areas of the delta has not been recognised as being as significant as they should have been. This is especially the case in areas where agriculture is the only form of employment and the resource distribution is unclear. Therefore difficulties with service factors are still in an obstacle. With low purchasing power, apart from some chemical materials farmers should buy, farmers are often responsible for all works of a labor-intensive production. The low investment has caused a low-productivity production, low saving economy, and in turn has impacted on future investment. Consequently, it is a vicious circle, which for many years, there are no measures to escape for a speeding up process.

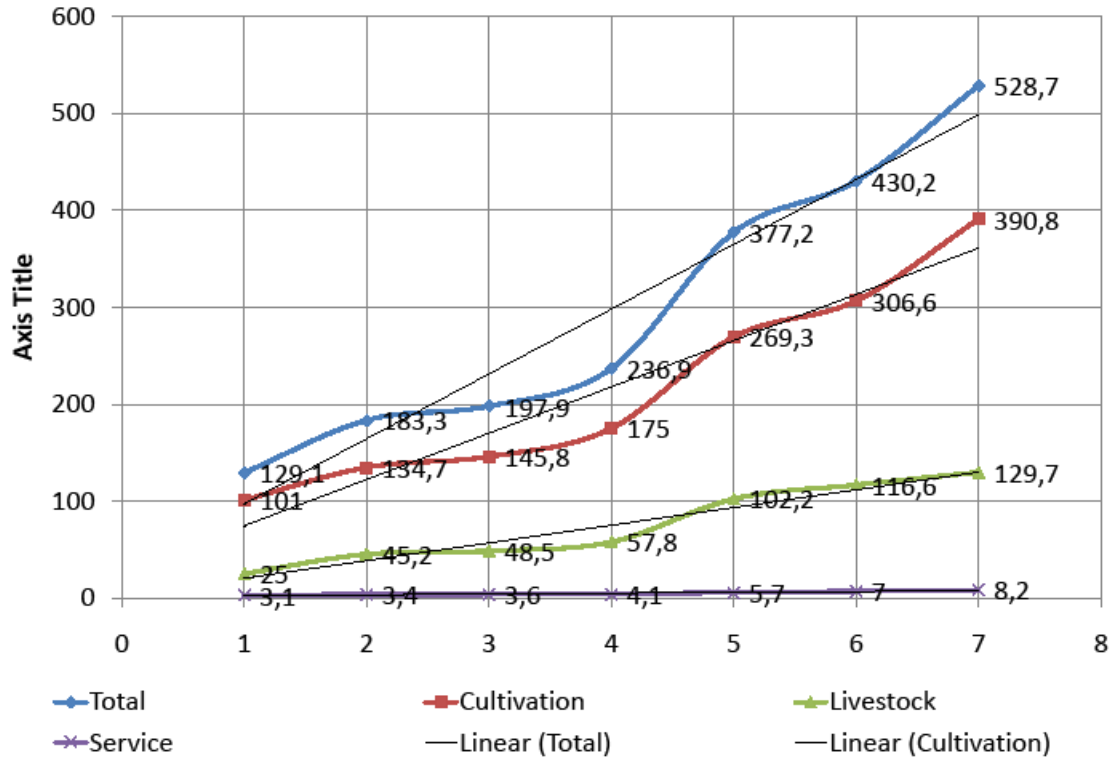


Figure 4.3: Gross output's structure of agriculture at current prices

Source: Statistical yearbook of Vietnam, 2010.

Table 4.2. Gross output's structure of agriculture at current prices

	Index (Previous year = 100) *(%)*			
	Total	Cultivation	Livestock	Service
2000	100.0	78.2	19.3	2.5
2005	100.0	73.5	24.7	1.8
2006	100.0	73.7	24.5	1.8
2007	100.0	73.9	24.4	1.7
2008	100.0	71.4	27.1	1.5
2009	100.0	71.3	27.1	1.6
Prel.2010	100.0	73.9	24.5	1.6

Source: Statistical yearbook of Vietnam, 2010.

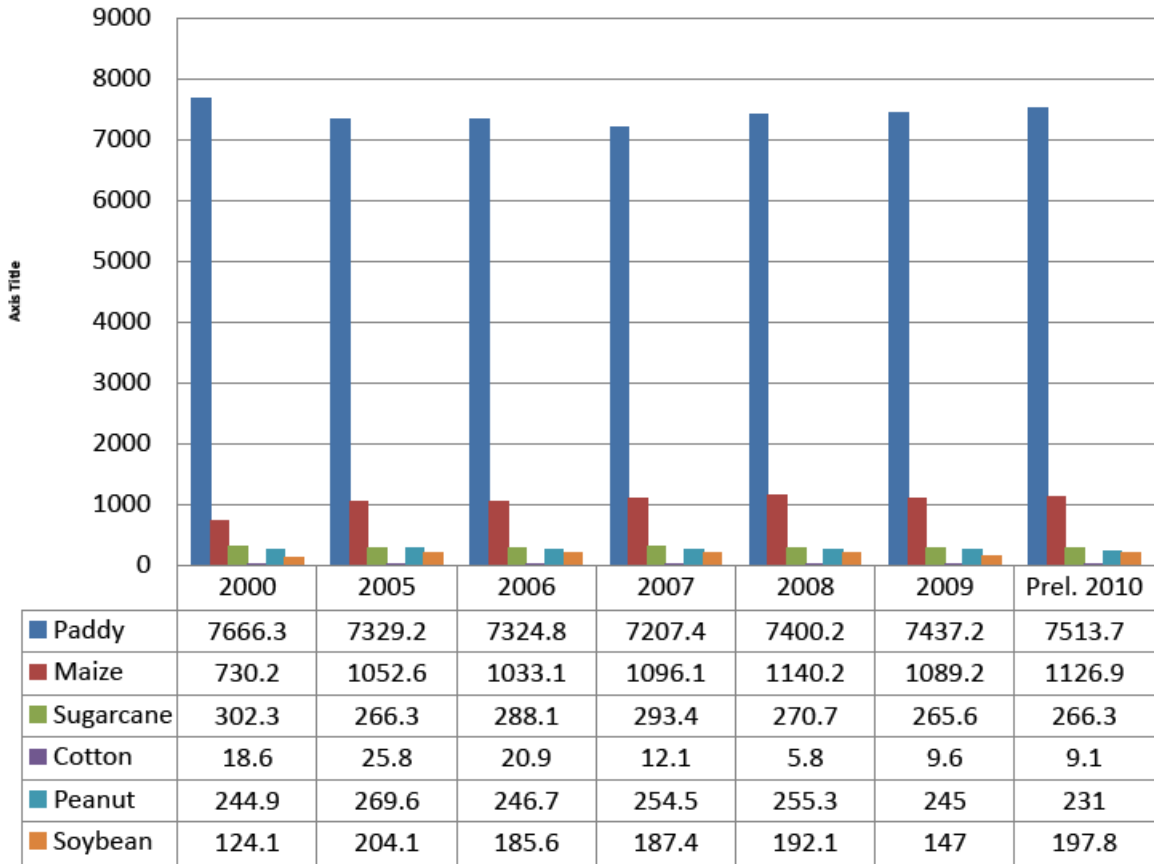
The value of agricultural production per one ha of arable land has increased continuously (Table 4.3), from 21 million dong in 2004 (about 1600 USD) to 45.5 million dong in 2009 (about over 2000 USD). Similarly for one ha of water surface for aquaculture was 42.5

million dong (about 3000 USD) and 87.1 million (about 4,000 USD). The highest increase was during 2008 for arable land and in 2007 for surface water aquaculture.

Table 4.3. Gross output of product per ha of cultivated land and aquaculture water surface

	Gross output (Mill. dongs)		Index (Previous year = 100) (%)	
	Cultivated land	Aquaculture water surface	Cultivated land	Aquaculture water surface
2004	21.1	42.5		
2005	23.6	47.4	112.1	111.6
2006	26.4	55.4	112.0	116.7
2007	31.6	67.4	119.4	121.6
2008	43.9	77.4	139.0	114.9
2009	45.5	87.1	103.7	112.5

Source: Statistical yearbook of Vietnam, 2010.



	2000	2005	2006	2007	2008	2009	Prel. 2010
Paddy	7666.3	7329.2	7324.8	7207.4	7400.2	7437.2	7513.7
Maize	730.2	1052.6	1033.1	1096.1	1140.2	1089.2	1126.9
Sugarcane	302.3	266.3	288.1	293.4	270.7	265.6	266.3
Cotton	18.6	25.8	20.9	12.1	5.8	9.6	9.1
Peanut	244.9	269.6	246.7	254.5	255.3	245	231
Soybean	124.1	204.1	185.6	187.4	192.1	147	197.8

Figure 4.4: Changing of areas of main annual crops by years (thousand hectare)

Source: Statistical yearbook of Vietnam, 2010.

In fact, there are some farming models which can be seen to be effective (vegetable farming in the vegetable growing areas of Haiduong, Hungyen, Hanam; fish-rice in combination farming in the low land areas of Thanh Tri belonged to Hanoi; Florists farming in suburb areas of Hanoi, Vinhphuc). However mostly the model of monotonous rice growing is dominant in the whole agriculture. Thus, the output value per hectare is still low and there is increasing demand for a new model where high yield/quality crops to be applied.

In cultivation, except paddy rice, the amount of land set aside for annual crops (Maize, Sugarcane, Cotton, Peanut, Soybean) is not large (Figure 4.4) and there are different growing trends (Figure 4.5).

The data in Figure 4.4 shows that the amount of land available for growing sugarcane, soybean and peanut is relatively small, and cotton acreage is not significant (only about ten thousand hectares). As such the soil's features in the region are not favourable for these crops, and the traditional habit of farmers in the region is to concentrate on only growing rice. Most of the arable areas within the region are reserved for producing food crops. It is also been revealed that the production structure of regional agricultural production is rather monotonous. Rice is dominantly grown in the region, and the other annual crops acreage is relatively small.

The data in Figure 4.4 and the tendencies shown in table 4.4 show that even the land available for rice production has decreased during 2005-2007, but still covered about 7500 thousand hectares. This is also the case with Maize where land available decreased in 2006, 2009, but still be maintained over 100 thousand hectares. This is also the case with Peanut's although the overall area available remains at around 240 ha. However, the sugarcane area erratically increased but overall there is a general decrease in land used for its production. This is also the case with Cotton area increased in 2009 but then decreased very rapidly, particularly in the years 2008 and 2007 and there has been a downward trend in the land used. Finally, the land use for Soybean production has been increased and decreased unpredictably. Therefore, the data reveals the unstable and fragmented development of cultivation. It has been suggested that the main reasons for these fluctuations as a consequence of unfavourable weather; the impact of climate change, too much rain fall, as well as droughts or frosts at certain times of the year. Therefore, facilitation should be strengthened to protect crops and to limit the harmful effects of natural disasters.

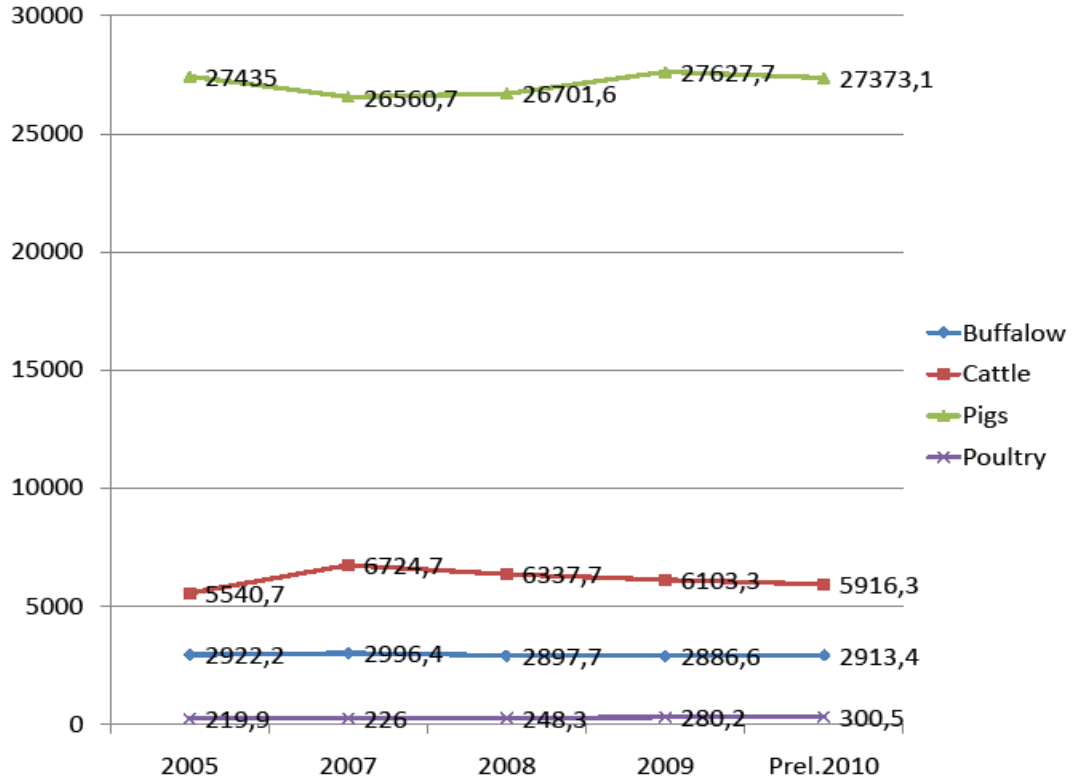


Figure 4.5: Livestock population (thousand heads)

Source: Statistical yearbook of Vietnam, 2010.

Table 4.4: Index of the planted area of main crops (Previous year = 100)

	Paddy	Maize	Sugarcane	Cotton	Peanut	Soybean
2000	100.2	105.6	87.8	87.7	98.9	96.1
2005	98.4	106.2	93.1	92.1	102.2	111.0
2006	99.9	98.1	108.2	81.0	91.5	90.9
2007	98.4	106.1	101.8	57.9	103.2	101.0
2008	102.7	104.0	92.3	47.9	100.3	102.5
2009	100.5	95.5	98.1	165.5	96.0	76.5
Prel. 2010	101.0	103.5	100.3	94.8	94.3	134.6

Source: Statistical yearbook of Vietnam, 2010.

In contrast to the situation of abnormal changes in the area, in the last 10 years, the productivity of all crops is almost continuously increased (Table 4.5). However in comparison to other countries in the world, the productivity of crops (except rice) is still low. Crops' yields are the difference between localities in the region, the highest paddy yield has been recorded in Thaibinh, and then in Haiduong with the lowest yields being

observed in Ninhbinh, whereas the highest soybean yields have been recorded in Haiduong. Furthermore the maize's yield is higher in the alluvial areas of Haiduong, Hungyen, Thaibinh while lower in interior fields. Such differentiation in productivity is firstly affected by soil fertility, but also depends on the farming traditions in each area.

Table 4.5. Yield of main annual crops (quintal/ha)

	Paddy	Maize	Sugarcane	Cotton	Peanut	Soybean
2000	42.4	27.5	497.7	10.1	14.5	12.0
2005	48.9	36.0	561.3	13.0	18.1	14.3
2006	48.9	37.3	580.3	13.7	18.7	13.9
2007	49.9	39.3	592.9	13.3	20.0	14.7
2008	52.3	40.1	596.4	13.8	20.8	13.9
2009	52.4	40.1	587.7	12.6	20.9	14.6
Prel. 2010	53.2	40.9	598.8	14.6	21.0	15.0

Source: Statistical yearbook of Vietnam, 2010.

The productivity of annual crops tends to be changed differently (Table 4.6). Notably, the increase of crop productivity is not consistent throughout the last 10 years. For instance, in 2005, productivity of cotton increased significantly while the increase of other crops' productivity was not significant. Alternatively, productivity of cotton, soybean and sugarcane has decreased during some years, but paddy, maize and peanut outputs have increased steadily. Agriculture in Vietnam depends heavily on natural conditions; therefore, diversifying crops is an essential strategy that farmers need to apply within the region.

Table 4.6. Production of main annual crops (thousand tons)

	Paddy	Maize	Sugarcane	Cotton	Peanut	Soybean
2000	32529.5	2005.9	15044.3	18.8	355.3	149.3
2005	35832.9	3787.1	14948.7	33.5	489.3	292.7
2006	35849.5	3854.6	16719.5	28.6	462.5	258.1
2007	35942.7	4303.2	17396.7	16.1	510.0	275.2
2008	38729.8	4573.1	16145.5	8.0	530.2	267.6
2009	38950.2	4371.7	15608.3	12.1	510.9	215.2
Prel. 2010	39988.9	4606.8	17396.7	13.3	485.7	296.9

Source: Statistical yearbook of Vietnam, 2010.

Since the 1970s, increasing the use of land by growing "winter crops" (Vietnamese terminology) is a requirement of practice. The production of vegetables has been successful in fertile soils as in Haiduong, however is more difficult in poorer soils in Vinhphuc. In comparison to other regions in the country, paddy's output in the RRD is relatively high, while the yields of other crops are low, especially cotton, soybean and peanut (Table 4.6). These crops are developed in specific areas by the characteristics of each plant; therefore, they do not compete with others in terms of area. The development of crops has long been influenced by the traditional farming tendency in each locality then agriculture is characterised by fragmented production.

Currently, due to the requirement for industrialisation and urbanisation, arable land has been put under pressure as the land is required for other uses. This is especially the case for rice growing areas. Therefore, in order to increase total output of agricultural products, it is clear that crops' productivity should be considered. As such, the role of S&T more than ever is becoming highly important.

In general, the increases or decreases in crop yields are volatile, especially cotton, soybean, sugarcane and peanut. Usually, the fluctuation of crops' yield depends on the change of two elements, area and productivity. However, in recent years, general changes in crops' yield in the region have mostly been dependent on productivity. Thus, productivity is the key factor determining crop yields, while the potential of crops' productivity is still available. In order to increase the crops' yield sustainably in the region, investment for infrastructure should be carried out, especially for irrigation, plant protection, and avoid the wasteful use of land for other non-agricultural purposes.

Within the livestock sector (Figure 4.5), pigs and poultry are the primary animals reared. The output of these products in the RRD is, are relatively large compared to others regions, and are developed from the forms of concentrate farming or dispersion in farmer household. Buffaloes used for ploughing and for meat partly, are scattered in farmers' household. Currently, crop preparation, especially land preparation is done mostly by machinery; therefore, the number of cattle is decreasing (nearly 3 million). Cattle are available on the form of concentrate farming in some communes of Ba Vi district, and Gia Lam district (Hanoi), and are mainly used for dairy farming.

Except a slight increase of production (especially from 2007 to present), the number of cattle increase or decrease unstable (Figure 4.5). There has been a marked decrease in the

number of cattle although the number of buffaloes has not fluctuated very much. However, the number of pigs significantly reduced in 2007 but numbers were restored in later years. Despite this the number of pigs decreased relatively more in 2010. These tendencies are shown in Figure 4.5.

Main products from livestock in the region are limited, in which the most living weight of pigs is only around 3 million tons (Table 4.7), and mostly consumed at a local market. This data reveals that livestock is relatively dispersed development, not to be strong commercial products. The advantages of the region for livestock is relatively significant, especially climate condition, breeding experience. Three main potential animals where the herd sizes could be expanded are pigs, cattle and poultry However, there are many difficulties in terms of epidemic prevention, capital investment and the effectiveness of farming methods. In addition the agricultural processing part of the industry is still weak which also constrains the development of livestock production.

Table 4.7. Main products of livestock (thousand tons)

	2005	2007	2008	2009	Prel.2010
Living weight of Buffaloes	59.8	67.5	71.5	79.1	84.2
Living weight of Cattle	142.2	206.1	226.7	263.4	278.9
Living weight of Pigs	2288.3	2662.7	2782.8	3035.9	3036.4
Slaughtered Poultry	321.9	358.8	448.2	528.5	621.1
Fresh milk	197.7	234.4	262.2	278.2	306.7
Egg (mill. pieces)	948.5	4465.8	4937.6	5465.3	6367.1
Honey	13.6	15.7	10.0	11.5	11.9
Silkworm cocoon	11.5	10.1	7.7	7.4	7.6

Source: Statistical yearbook of Vietnam, 2010.

Generally, information on production and population within the region can be shown through data of products per capita (Table 4.8). The data in Table 4.8 shows that agricultural production in the region is quite fragmented with many different products being produced.

Paddy is the main product and its index per capita is high, ensuring issue of food security, and is a commodity product of the region. Although output reduced slightly in 2005 and

2007, more recently it has increased again. In addition the living weight of pig is the second most important product for the area and increased continuously from 2005 to 2009 with only a slight decrease in production in 2010. Further to this, products such as cashew nut, pepper, coffee, tea have a high potential to become commodity products, however, there are grown dispersedly throughout the region. Livestock products such as living weight of buffaloes, living weight of cattle and poultry have little potential to become commodity products and therefore serve mainly for domestic demand, to be consumed in the local markets only.

Table 4.8. Some agricultural products per capita (kg)

	2005	2007	2008	2009	Prel.2010
Paddy	434.9	426.8	455.0	452.8	460.0
Cashewnut (Điều)	2.9	3.7	3.6	3.4	3.3
Pepper	1.0	1.1	1.2	1.3	1.3
Coffee	9.1	10.9	12.4	12.3	12.7
Tea	6.9	8.4	8.8	9.0	9.5
Living weight of buffaloes	0.7	0.8	0.8	0.9	1.0
Living weight of cattle	1.7	2.4	2.7	3.1	3.2
Living weight of pig	27.8	31.6	32.7	35.3	34.9
Poultry	3.9	4.3	5.3	6.1	7.1

Source: Statistical yearbook of Vietnam, 2010.

4.4. Stages of applying innovative advancements in agriculture

The stages of applying S&T's achievements in agricultural production of the region are consistent with the developmental stages of scientific and technological revolution in agriculture of the country. Although results of the Green Revolution have positively influenced the development of regional agriculture, efforts made by the Vietnamese government in generating a favourable environment for development has played a major role in the development of the region. Results and issues arising from the process of innovation in agricultural production are compatible with the general situation of the country.

Natural conditions, especially socio-economic factors have changed relatively much across different stages. Therefore, this study focuses on the modern periods, roughly divided into

three periods: i) the early 20th century, ii) the period when peace was restored in the north to 1986 and iii) the "doi moi" period from 1986 until the present.

The study applies this divide because after the restoration of peace in the north of Vietnam, two basic milestones for Vietnam society were achieved: the development of S&T began strongly in the early years of the 20th century which remarkably changed rural areas from a feudal system to that of a modern society. While the second milestone in 1986, marked by the enactment of the "doi moi" policy promulgated by Vietnam Communist Party as a ruling party that is the fundamental start of inspiration for a new era of the country today. In each stage of agricultural development, depending on the particular context, the Party and the Government has issued policies' guidelines regarding the transferring and applying innovations in agriculture.

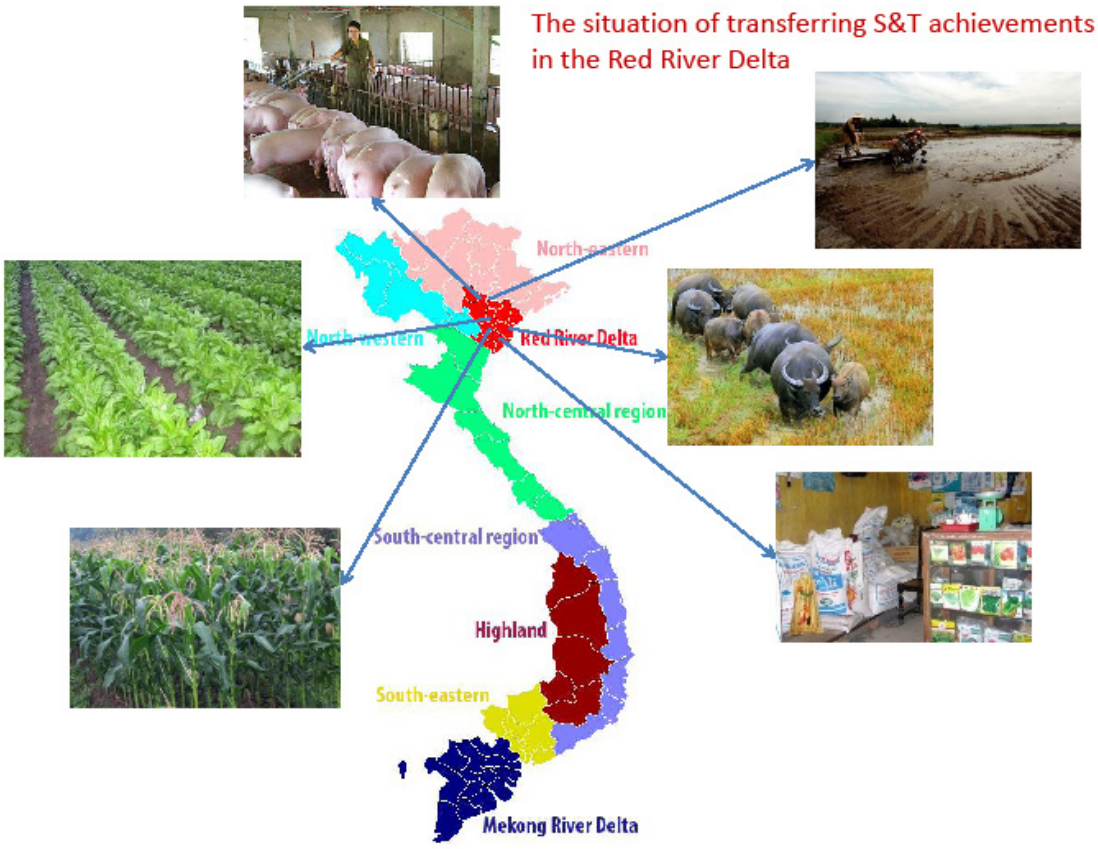


Figure 4.6: Imagination on the application of advanced technology in agricultural production in the RRD

Source. Combination among own pictures and collected pictures.

4.4.1. The period of beginning 20th century

In the first period, the basic features of the socio-economic conditions of the region are as follows:

Before 1945, Vietnam was a colonial semi feudal country, characterised by poor agriculture, backward and fragmented production, a rice monoculture, self-sufficient (autarkic production), and very much dependent on natural conditions. Furthermore, yield and productivity were low and unstable. In 1929 (the year of agricultural success in the French colonial period), rice's yield was only 1200-1400 kg/ha (Dao, 2000).

The economy depended heavily on local features, self-sufficiency (autarkic production); farms were surrounded by bamboo fences and distinguished by cultural boundaries at the village level. Farmers' households were a basic economic entity, placed in a relation with villagers and relatives. During this period, arable land was distributed unequally, concentrated in the hands of the feudal landlord classes, while up to 50% of farmers were landless. Economic development was at a low level.

- Socially, in rural areas, three basic institutions including family, relatives (family line) and village's regulation (regulation of males in the village) strongly influenced the economic behaviour and cultural behaviour of agricultural residents.
- Methods of agricultural production during these years were mostly traditional, and heavily affected by natural disasters. In northern Vietnam between 1925 -1926, the number of times the dykes failed was accounted 35 times. The irrigation system inherited partly from the period when Vietnam was a French colony, which was operated by auto-gravity without artificial fully controls. Water for agriculture was taken mainly from natural surface water. Agricultural technology was simple, labour-intensive and served mainly the rice monoculture. Other sectors were not developed. Rice's productivity was low, only about 1200 kg per ha.

4.4.2. The period from recovery of peace in Northern to 1986

4.4.2.1. The period of economic recovery (from 1954 - 1960)

North Vietnam entered a period of economic recovery during the mid 1950's. During this time arable land was distributed to individual farmers. Although productivity increased, but tillage was very backward. Using S&T capabilities, the new Government of Vietnam invested in building leading agricultural research institutes such as the Institute of Food

Plants, the Institute of Industrial Plants, as well as the Institute of Animal Husbandry and the Institute of Agriculture and Forestry.

Agriculture in this period was still characterised as being labour-intensive and almost all farming was carried out manually. Production was also more traditional rather than that of modern production. The model of production was relatively simple, mainly due to the utilisation of irrigation and the organic fertilisers. Initial features of agriculture in this period were an extensive farming, rice's monoculture, low productivity and exploitation the advantages of the natural fertility of the soil.

As the result of a considerable effort and a massive movement away from a feudal system, the establishment of agricultural co-operatives in the North (1958-1960) was carried out. This meant that the arable land of individual farmers was gradually collected and shifted to local cooperatives. During this period, rice remains the monoculture crop on the fields of Vietnam.

4.4.2.2. The period of agricultural cooperatives until the "green revolution" in the North (1961 - 1970)

A campaign of applying technical improvements (1964 - 1965) was conducted in most of the co-operatives to utilise a series of new techniques for rice production. In a co-operative, a technical team was established which was responsible for receiving, managing, and diffusing the application of new technologies. In this period, irrigation was considered as the most relevant measure, then following these measures including the use of machinery and chemical fertilisers. It was at this time that chemical fertilisers started to be used on fields. Therefore the technologies used within the agricultural sector focused on the utilisation of irrigation, the mechanisation of the sector, as well as the use of chemical substances and crop rotation. This created a new awareness among farmers about how to apply technical improvement in production. As a result, the model "five tons field" (five tons of paddy per a hectare for two crops) provided a positive contribution towards solving the difficulties experienced during the war.

In this period, the task of seed selection was considered as highly valuable work.

4.4.2.3. The period from 1971 to 1986

Since 1971 the "green revolution" had been booming in northern Vietnam, in which the first new cultivar of winter - spring high yields rice with short growing time was used in fields in northern Vietnam, replacing the traditional rice with long growing time and low

productivity. Further to this many other technical improvements were applied such as growing rice in line in the direction from east to west, using more fertiliser especially those which contained chemicals.

New varieties of other crops (like maize, potatoes, peanuts and tea, sugarcane and others) became popular. In fact, hybrids featured by high productivity were developed in parallel with the utilisation of new rotation formulas, i.e. the implementation of winter crops. During this period the productivity of crops in winter-spring time was higher than productivity those produced during the autumn-winter. Many areas in the RRD reached the productivity of five tons of paddy per hectare; typically Thaibinh was the province where this indicator was achieved in the overall area.

Due to the influence from changes in cultivation many new breeds were introduced and became more widespread especially new hybrid breeding programmes, for instance, F1, F2 hybrid pigs between domestic breed and Becshai, Yooshai, Duroc, or Hundras; or Sind hybrid cow between domestic cow and Sind cow, or Tam Hoang chicken, and others.

Vietnam had persevered previous programs, in which it had paid much attention to biotechnology and considered intensive farming with high productivity as one of the basic measures for agriculture's development. The use of pesticides also started during this period and a number of models were introduced and put into practice for example winter crops, a model of combining garden-pond-cage (in Vietnamese called VAC), a model of making hybrid seed/breed at the farmer household.

Although the strong development of transferring technical advancements and applying them on the field during the 1970's and 80's was recognised, due to the weakness of administration and inflexible management mechanism (even the war had come to end in 1975), the economy in general and agriculture in particular had not escaped from stagnation. Faced with this difficulty, the Secretariat of Central Committee of the Communist Party issued a Directive Nr. 100/BBT (1981) about lease for agriculture which assigned a certain amount of products to individual farmers or group of farmers. This leads to the increased self-responsibility of farmers in association with the administration of cooperatives. Through the implementation of the Directive 100/BBT, although agricultural production had initially achieved better results, and technical advancement had been implemented better than previously, due to the sluggishness of the administration of

agricultural co-operatives and the impact from a severe economic crisis between 1985 to 1987, agricultural production had been decreasing for a long time.

4.4.3. The period of "doi moi" (from 1986 to current)

With the enactment of the Resolution of Congress VI (1986), Vietnam's economy changed radically, from leadership's political-will to a more market oriented economy. This was a simultaneous combination of market mechanism and macro-management of State. As a result, farmers are freed from constraints and they can carry their production as their willingness.

Since then, several policies have been issued which improve on the changes implemented with the Resolution of Congress, such as the land use policy, the policy for economic restructuring in rural areas, the agricultural extension policy, the rural credit policy and many others. These provide a favourable environment for the development of farmers' households. In addition the industrialisation and modernisation of agriculture and the rural areas of Vietnam has promoted the application of innovative advancements in production. New models of transferring innovative advancements to farmers have been collected and summarised to reflect the co-operation among farmers, scientists, entrepreneurs and local authorities.

Several programs were carried in this period, typically they are[22]:

- The program of applying technical advancement in producing F1 hybrid rice. After 15 years, the program educated, introduced and transferred the technique of producing hybrid seed to farmers in 26 provinces/cities through demonstrating a sample model for training and visiting (T&V), in which 100% provinces/cities of the RRD were included, as well as with the participation of other 40 organisations. The total area allocated for hybrid rice has increased from 173 ha (1992) to 1500 ha (2000-2005) and 1300 ha (2006-2008). The productivity of rice for seed has also increased from 300kg/ha in 1992 to 2500 kg/ha in 2000s. In favourable localities and with favourable weather conditions, the productivity has reached 3800-4000 kg/ha and the seed's quality has been confirmed as being of a good standard. The price of domestic seed is equal to 60% of import price. The situation has changed the figure of 100% hybrid-rice-seed importing to just only 75% the other 25% is produced by domestic suppliers. Currently, there are many good domestic hybrid

[22] According to reports of Ministry of Agriculture and Rutal Development

rice seeds available in the market as TH3-3, TH3-4, VL20, VL24, HYT83, HYT100, HYT102, HYT103.

- The program for development of hybrid rice as commodity: this program has been expanded in most provinces/cities in northern and High Land region of Vietnam. The average productivity has reached 6500 kg/ha, even 10,000 kg/ha in certain localities. In recent years, the areas of hybrid rice for commodity goods have reached 620-650 thousand hectares in Vietnam with a higher productivity of 1000-1500 kg/ha compared with normal rice.
- The program of applying technical advancement to develop high-quality rice: The program was initiated in 1997, and concentrated on two main granary areas in the Red River Delta and Mekong River Delta. This has been expanded to all regions and rice-growing provinces throughout the country, to ensure the increased consumption of domestic demand and export. The program has concentrated in introducing demonstrative samples of Bac Thom Nr. 7, Huong Thom Nr. 1, P rice varieties, VD20, VND95-20, MTL499, Jasmine, mutant Basmati, local special rice varieties as Tam Xoan, Du, Nang Huong, Cho Dao.
- The program of restructuring crops and plants: In this program, farmers have been encouraged to shift from growing rice in less productive areas to other plants such as corn, peanuts, soybeans, vegetables, and others. Alternatively they have been urged to change the structure of rice crops towards higher yields and crops which are more efficient. In northern provinces, particularly localities in the RRD and northern midland, there has been a significant shifting from winter - spring rice to late spring rice to ensure safety from unpredictable change of weather in winter as well as creating more space for expansion favourable winter plants. The proportion of land used during the late spring season has increased from 25% to 50-55%. In addition, the land used for early winter crops has increased by 40%. The sowing method whereby the use of improved machinery has been widely applied in all provinces since 2005. The benefits in comparison with traditional cultivation are stark as it reduces heavy works, to increase labour productivity and has also reduced the cost of seed from 45-50kg/ha to 22-30 kg/ha. This has also led to a reduced growing time of 7-10 days shorter than normal transplanted rice. Moreover, this application of new improved methods has contributed a positive influence to areas' expansion of late spring rice and early winter crops.

- The program for development of hybrid maize: The yield of maize increased from 2110 kg/ha in 1995 to 3200 kg/ha in 2004 and in nearly 4000 kg/ha in 2008. The proportion of hybrid maize areas has also increased from 20% in 1992 to over 80% in 2008. The program of applying technical improvement in hybrid maize production has been implemented on 8870 ha of agricultural land, of which 1,100 hectares accounts for seed production, and remaining 7770 ha for intensive farming. The productivity of hybrid maize for seed had achieved 2500-3000 kg/ha, when the price for one kg maize seed produced inland is only two-thirds of foreign imported seeds. Many new hybrid maize varieties as LVN10, LVN4, B9698, DK888, DK999, C919 are used in the program particularly those which have brought a high economic efficiency. Farmers have also recognised the benefit of applying new hybrid maize in their production. The program has contributed to achieve the goal of 1 million hectares of corn, and a yield of 4 million tons in 2010.
- The program of applying new standards for safe production: To minimise the risk of increasingly serious environmental pollution, or pollution of vegetable products, the program has transferred innovative advancement regarding Vietnamese Good Agricultural Practices (VIETGAP) for safe vegetable production. Over 100,000 vegetable producers, formulated 5540 hectares of sample crops in all localities throughout the country. Vegetable products have been gradually moving towards food-safety standards, and as a result the income from vegetables for farmers now totals 250-300 million VND/ha/year some vegetable crops may also bring a return of more than 400 million VND/ha/year.
- The program for development of short-term industrial crops: This program has introduced many innovations to farmers with regards to producing short term industrial crops, for instance, a technique of using plastic to cover peanut plants has increased productivity by 20-25% compared with no cover. This has resulted in yields reaching up to 5000 kg/ha. The benefits of applying new advanced technique in peanut production are twofold, firstly the exploitation of an extra efficient crop featured by high yield, high productivity, and secondly the process allows for the preservation of the peanut's seed for next spring seasons. Until now, the program has supported the production of hundred thousands of tons of good-quality peanut seeds L14, L18, L23, MD7; soybean DT84, DT99, DT12, D96-02, HL2; sugarcane ROC10, ROC16, Que duong, and others..

- The program for development of long-term industrial crops: This program plays a pivotal role for socio-economic development within the region. For instance, techniques of grafted greening have been popularised in most provinces where nursery citruses are grown, and ten thousands of good saplings of orange, tangerine, grapefruits are sold in the market. In addition, the model of applying intensive farming in gardening in combination with many new advanced techniques such as the high survived rate of grafted technique for longan, mango, litchi has improved the quality of fruit significantly. This has shortened the growing time of fruit trees by up to three years in comparison with normal growing methods. The program has formulated 6525 sample models with total support of 30 billion VND.

In conclusion, the analysis in this chapter has revealed:

- Cultivation dominates the agricultural production in the region, in which paddy rice is still a major cultivar. Other branches as livestock and aquaculture occupy a minor proportion in total gross output value. These products are purchased and consumed mostly at locality. Almost agricultural products are raw products and the processing industry is still undeveloped.
- Initially, the production in the region has started to exploit the local advantages towards commodity production.
- Initial programs focusing on enhancing the transfer and application of S&T's achievement have been conducted. Over time, the motivation of these programs has been changed from administrative controlled towards market mechanism. These programs cover a wide spectrum from technical issues to managerial issues. Much technological advancement has been introduced to the farmers. Similarly, advancements regarding managerial issues and administrative pattern have also been regarded as the necessity for an effective agricultural, for instance, IPM (integrated pest management) has been applied within the agricultural sector since the late 1980s.
- In the process of transferring innovative advancements to farmers, the government has played a positive role. Changing to new mechanisms, the government has consistently facilitated the way of controlling the agricultural sector from command management to flexible administration. A broad network of state extension services have widely spread out from the central administration to farming communities,

which has supported farmers and helped them to understand and comprehend innovation and helped to implement their application in agricultural production.

Current Problems:

- Knowledge of farmers on technical issues and their application is remarkably low and this knowledge is spread unequally across farmers within the region. In the process of transferring innovations to farmers, the over-focus formalism and making achievements in the fight against `diseases' of the transferees has limited the autonomy of farmers in adopting innovations.
- There are still many constraints when applying innovations to production, such as financial deficiency, discrete knowledge. In addition farmers do not always strictly comply with the instructions provided for them and often skip some steps. Further to this the continuous flow of innovation to farmers is not maintained causing by many difficulties that does not create a system of applying innovations of farmers.
- Natural resources are exploited exhaustively not only for agricultural production but also for the non-agricultural purpose as industry and urbanisation. Environmental pollution is also considered as an increasing problem in addition to emerging issues surrounding food safety.
- Finally there are a number of other problems within the agricultural sector today including the decrease of agricultural land, stagnation in agricultural economic restructuring, finding enough skilled labor, as well as the fragmentation of innovations. Therefore in some places farmers are not very keen on applying innovations.

5. EMPIRICAL RESEARCH ON THE PROCESS OF TRANSFERRING/APPLYING INNOVATIVE ADVANCEMENTS IN AGRICULTURAL PRODUCTION IN THE RRD

The following results have been generated from empirical research of the study. In the framework of the study, a survey had been conducted to collect primary data from 85 farmers' households and 15 experts. The survey relied on two semi-structured questionnaires in order to collect qualitative and quantitative data, in combination with open talk and filling data in designed forms. In addition, information from the internet has also been analysed to demonstrate academic viewpoints on the subject.

The topics of analysis have been arranged in the following order to provide a clear picture about the transfer and application of innovative advancement in agricultural production throughout the region.

- Playing the role of recipients and beneficiaries of the transfer of innovative advancements, farmers and their behaviour under the influence of endogenous factors such as educational levels, health, economic wealth, their understanding of innovations and innovative advancements have been analysed.
- Further to this, the external factors also called exogenous factors, for example, the development of infrastructure, sources of information about innovations, has been examined within the study.
- In addition, the behaviour of transferees and creators of innovations, and methods of contacting farmers has been analysed as this would affect the results and effectiveness of transfer and application of innovative advancement in agricultural production.

5.1. System of agencies supporting the transfer of S&T's achievements to farmers

In order to explore the responsibilities of agricultural, managerial agencies in the RRD region, an investigation on the structure and figure of local system reveals that there are three levels of administrative management, divided into provincial level, district level and communal level within the region.

At the provincial level, two typical organisations, the Department of Agriculture and Rural Development (DARD), and the Department of Science and Technology (DOST) are two main organisations to be responsible for managing agriculture and governing the process of

transferring S&T's achievement to farmer in the region. The DARD has extended it's root to district level and communal level, while the DOST has extended to district level only. Theoretically, the DARD is responsible for a wide range of managerial tasks in agriculture and rural areas, while the DOST is responsible for creating a favorable environment or providing incentives for the development of S&T in the region, in which S&T in agriculture has also been an important part. In reality, DOST has also its own programs to transfer S&T' achievement to farmers in the region. (Figure 5.1).

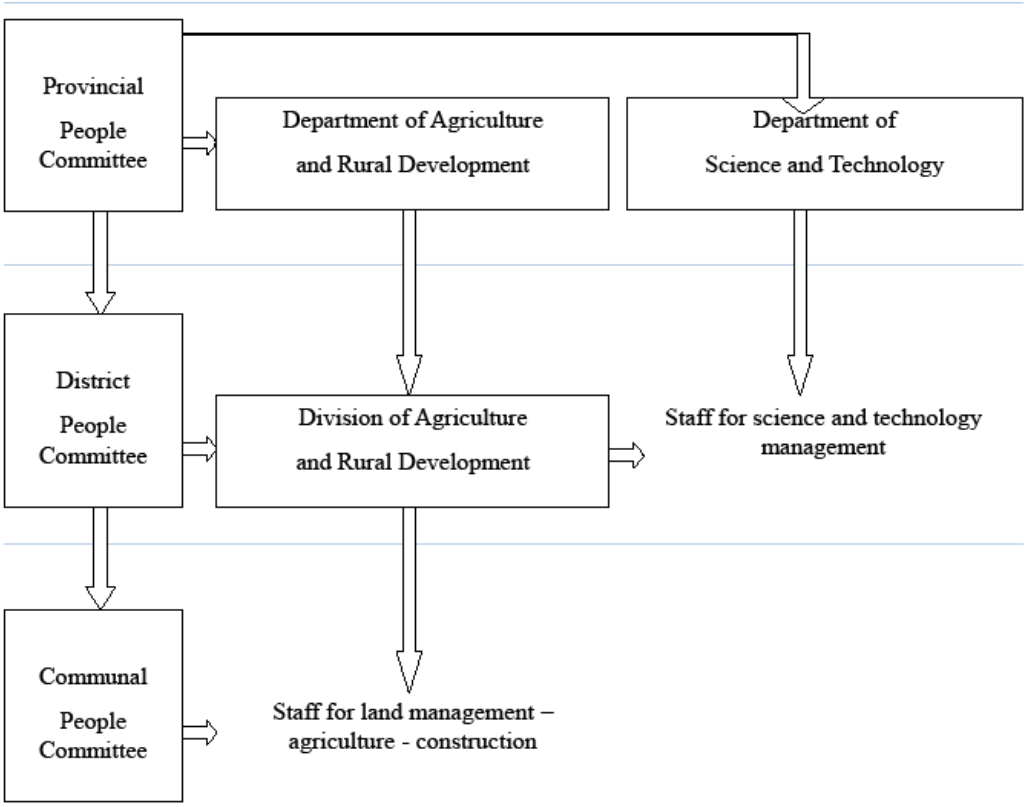


Figure 5.1: Three levels of local administrative agencies in managing the activity of transferring innovations to farmers in the locality.

Source: Own compilation.

At the provincial level, within the organisational structure of the Department of Agriculture and Rural Development, the Centre of Extension Services specialises in transferring innovative advancements to farmers and enhancing the process of applying technological innovations on the field. Two other units belonging to the Department of Agriculture and Rural Development are the Department of Plant Protection, and the Department of Veterinary. These departments are also involved in providing administrative management and transfer of techniques in plant protection and veterinary medicine to

farmers. In some specific areas where forestry and aquaculture are available, the organisational structure might also include the Department of Forestry and the Department of Aquaculture in charge of the main forestry and fisheries.

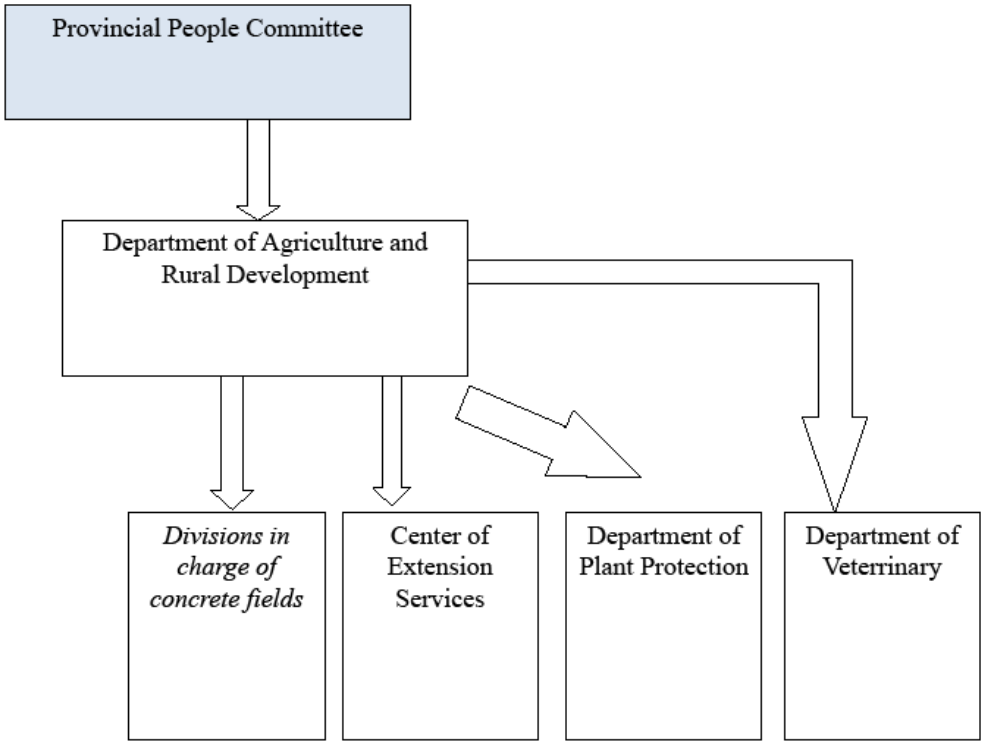


Figure 5.2: The organisational chart of provincial agencies in charge of managing and transferring agricultural innovations to farmers

Source: Own compilation.

Although the Centre of Extension Services at the provincial level belongs to the Department of Agriculture and Rural Development, but it is also shared with the National Department of Extension Services in a vertical relationship. Most of the budget assigned to the Centre of Extension Services is from the National Department of Extension Service. The same organisational chart can be applied for the Department of Plant Protection and the Department of Veterinary. Annually, a large proportion of the budget is allocated to allow the process of transferring technological innovations to farmers in the region to be conducted.

The functions and tasks of the DOST cover all the management of S&T in all fields; thus S&T in agriculture is only a part of its operations. In reality, the DOST has conducted some projects with the task of transferring technological innovations to farmers. These

projects are typical linear models, to transfer advancements from R&D organisations to farmers following to linear approach. Besides the direct involvement in technological transfer, the most pivotal role of the DOST is reflected in its mission to manage and provide incentives for R&D and to participate actively in transferring technological innovations to farmers. For instance, the DOST is responsible in organising tech-mart, technological exhibitions, as well as providing financial support for experimental research conducted by R&D organisations, the management of the standardisation and measurement, conducting provincial S&T programs, and so on. Currently, the DOST consults the Provincial People Committee for policies of managing operations of all R&D organisations in the provinces. This also includes all R&D organisations in the agricultural sector.

Recently the tasks of transferring S&T achievements to farmers are carried out in two ways: (1) as a part in socio-economic programs or (2) as function and task of specific agencies as extension services. For the first type of transfer, these programs are usually conducted by divisions at the DARD, or other specific programs of the DOST, while the second type of transfer is conducted by the Centre of Extension Services.

At the district level, the Division of Agriculture within the District People Committee department is responsible for state management of agriculture at the district locality. the Division of Agriculture has conducted many development programs to promote the application of agricultural innovations, and to promote the co-operation among local organisations such as agricultural co-operatives with other R&D organisations. However, there are other subordinate agencies to be responsible of transferring technological innovations to farmers, including the Station of Extension Services, the Station of Plant Protection and the Station of Veterinary. The organisational structure of this system at the district level is not the same as at the provincial level. The other three later agencies in some locality do not be involved to the Division of Agriculture. For instance, in Kien Thuy-Haiphong, the Station of Extension Services belongs to the Division of Agriculture, while in Xuan Quan-Haihung, it is not. At the later case, the cooperation between these agencies is not synchronous, leading to the risk of differences and overlapping in implementing when doing the task of transferring innovations to farmers. Normally, the second type of organisation is very popular within the RRD.

In order to coordinate the activities of these agencies at locality, the Division of Agriculture coordinates a meeting among such agencies once or twice a month, where they

share their ideas and plans, and their schedule for consultation and co-ordination. However, these organisations have their own budget allocated from mother agency, for instance; the Station of Extension Services gets its budget mostly from the provincial Centre of Extension Services, while the Station of Plant Protection and the Station of Veterinary get the majority of their budget from the respective provincial departments. Therefore, without an effective co-ordination, they only carry out work related to the assigned budget from the mother organisation. They are also limited by the amount of co-ordinated resources and, as a result, the cooperation among them is not close, and in some cases they work independently from one another. An administrative shipment such as combining these agencies under the control of the Division of Agriculture does not solve the problem. The solution should come from allocating a common budget and, therefore, encouraging co-ordination among them.

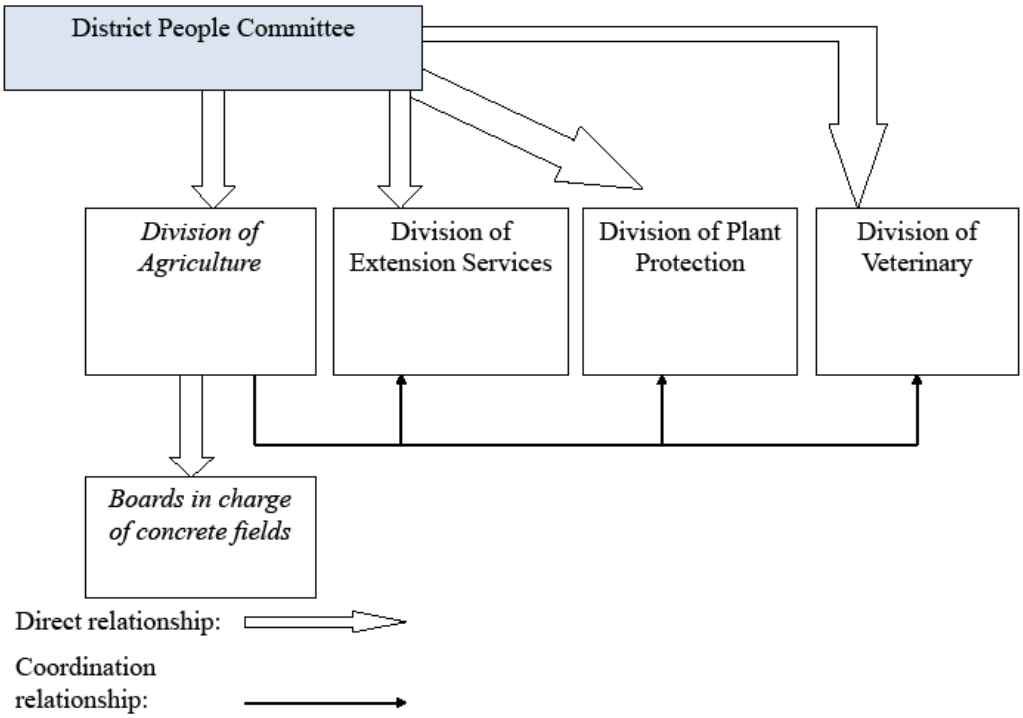


Figure 5.3: The organisational structure of the system of agricultural administration at the district level

Source: Own compilation.

At district level, there are also two similar activities to transfer S&T's achievement to farmers. 1) Through programs or projects; or 2) through the functional missions and tasks of specialised units on the district boundaries. Thus, if the project takes place on the

adjoining areas among districts, coordination between other related organisations is required.

In principle, at the district level, the activities of transferring S&T's achievement to farmers should be co-ordinated by the Division of Agriculture; however, in practice it does not always happen. These agencies in reality are carrying out the same operation independently from each other. In many cases, the Division of Agriculture, the Station of Extension Services, the Station of Plant Protection, and the Station of Veterinary are independent of their own operation concerning the transfer of agricultural S&T's achievement to farmers. In operation, the Station of Veterinary is primarily responsible for health of livestock, the Station of Plant Protection is responsible for crop protection at risk of disease, insect, pests, plant processes and plant care, whereas the Station of Extension Services is primarily responsible for the technological innovations in seed, fertilisers, and other advancements.

In addition to the above specialised agencies, the local administrative agency, the Division of Agriculture, through the implementation of coordinative tasks between these organisations, and the implementation of socio-economic programs or projects, is also involved in the process. It conducts localised programs or projects in order to create momentum for the development of local agriculture towards modern and commodity production. Unlike other programs and projects of business enterprises, which primarily focus on profit, this local state agencies focuses on building T&V models and creating a learning mechanism to allow farmers to benefit from the models.

There are mainly two types of programs which include short-term (annually) and long-term programs. They should be in conformity with the direction, planning and agricultural development needs of the locality and funded by allocated local budgets. These programs mostly focus on technological issues, and investment for them comes from state budget. They are not truly concerned with creating a favourable environment for co-operation between farmers and other actors in order to transfer S&T's achievements to farmers.

Next to the operation of above agencies, the representatives of the DOST at district level concern very much with environmental issues rather than S&T issues, because these S&T issues are mainly carried by the DOST at the provincial level.

The Communal People Committee is the most basic official unit at the locality to carry out administrative management directly for around 2000 households (Figure 5.4). This organisation is also responsible for connecting farmers in the locality and other partners from outside. Under the governance of this agency, several local associations of farmers such as the Farmers Union, the Woman's Union, the Young Union, the Agricultural Services Co-operatives and Clubs of Interest are functioning. According to the new Decree No. 92/2009/ND-CP, the number of staffs at communal level getting the salary from the state budget is around 17-21 people including the Chairman of the Farmers Union, Chairman of Woman's Union, Secretary of Yong Union, as well as the staff for agriculture-environment-construction. The communal extensional technician, however, does not get monthly salary from the state budget but instead receive grant (in equivalent to 6-10€ monthly) from the mother extension agency and a compensation from farmers in the region (equivalent to 200kg of unprocessed-rice per year). The total compensation gradually increases depending on the amount of work which has been completed, however, in practice; this income does not satisfy all the needs of the technicians. Despite this, these representatives have played a decisive and positive role in serving farmers' needs and in helping to connect farmers with other partners in getting the new things. For instance, the representatives of extension services are responsible for consulting farmers and providing them technical documentation, providing guidance for the implementation of new production's procedures, or introducing technical advancement to farmers. Furthermore, they report feedback from farmers as well as farmers' requirements to the mother organisation, whereas the representatives of plant protection and veterinary play the role of consultants in their fields.

In practice, these representatives also provide services for problem solving, i.e. treatment for husbandry diseases. They are quite popular in rural areas and are normally the first point of call when farmers need help or consultancy. That is why in the following parts, farmers give a positive evaluation on their role in helping farmers solving their problems or satisfying their needs.

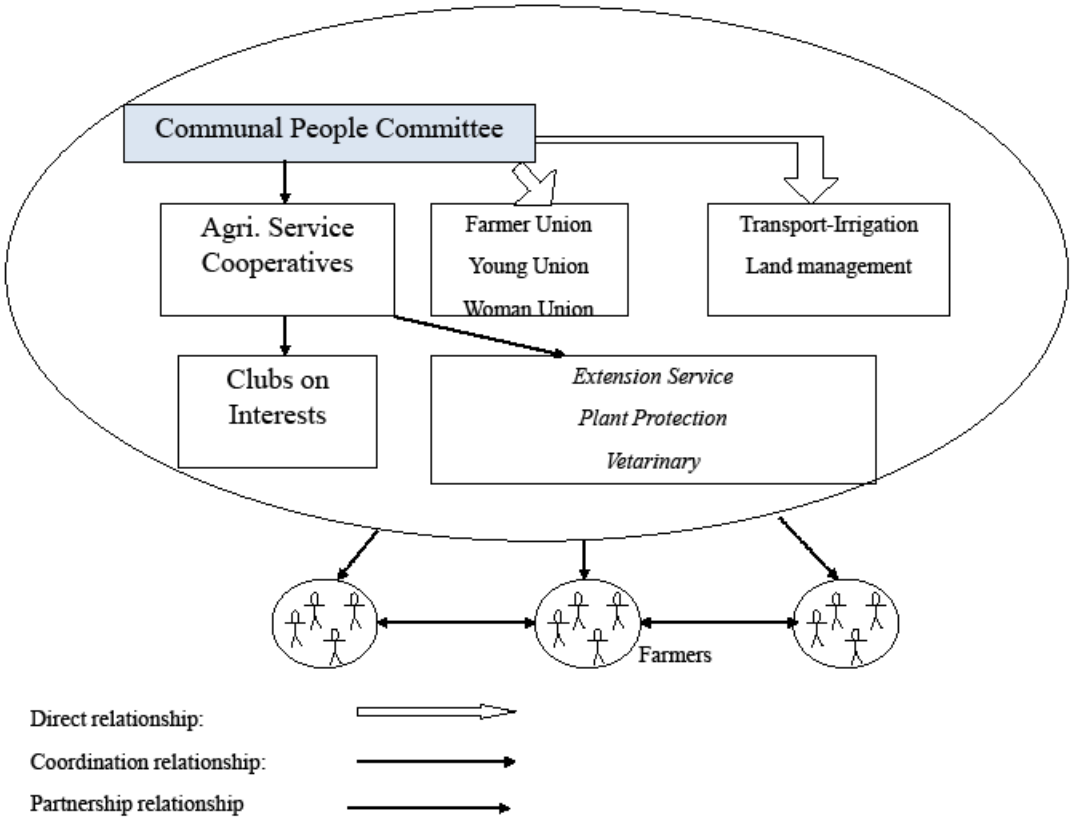


Figure 5.4: Organisational chart of the state system at communal level regarding to transfer innovations to farmers

Source: Own compilation.

These figures describe the system as a hierarchical coordination to manage the process of transferring S&T's achievement to farmers in the region. The figures reveal the available of three main flows of innovations, in which two official flows conducted by two state agencies, DARD and DOST, while the another flow is adjusted by the market mechanism.

- The first flow should be the structured agricultural system of administrative management. There are two typical organisations in this system, including the DARD and the Centre of Extension services. The typical DARD conducts socio-economic programs in which transfer of S&T's achievement to farmers is associated to concrete activities. The Centre of Extension services regulates the functions and tasks as well as carries out the transfer of technological innovation to farmers. The transfer is usually considered to be a top-down model. In order to consider the requirements of users, feedback from users of innovations has been taken into account.

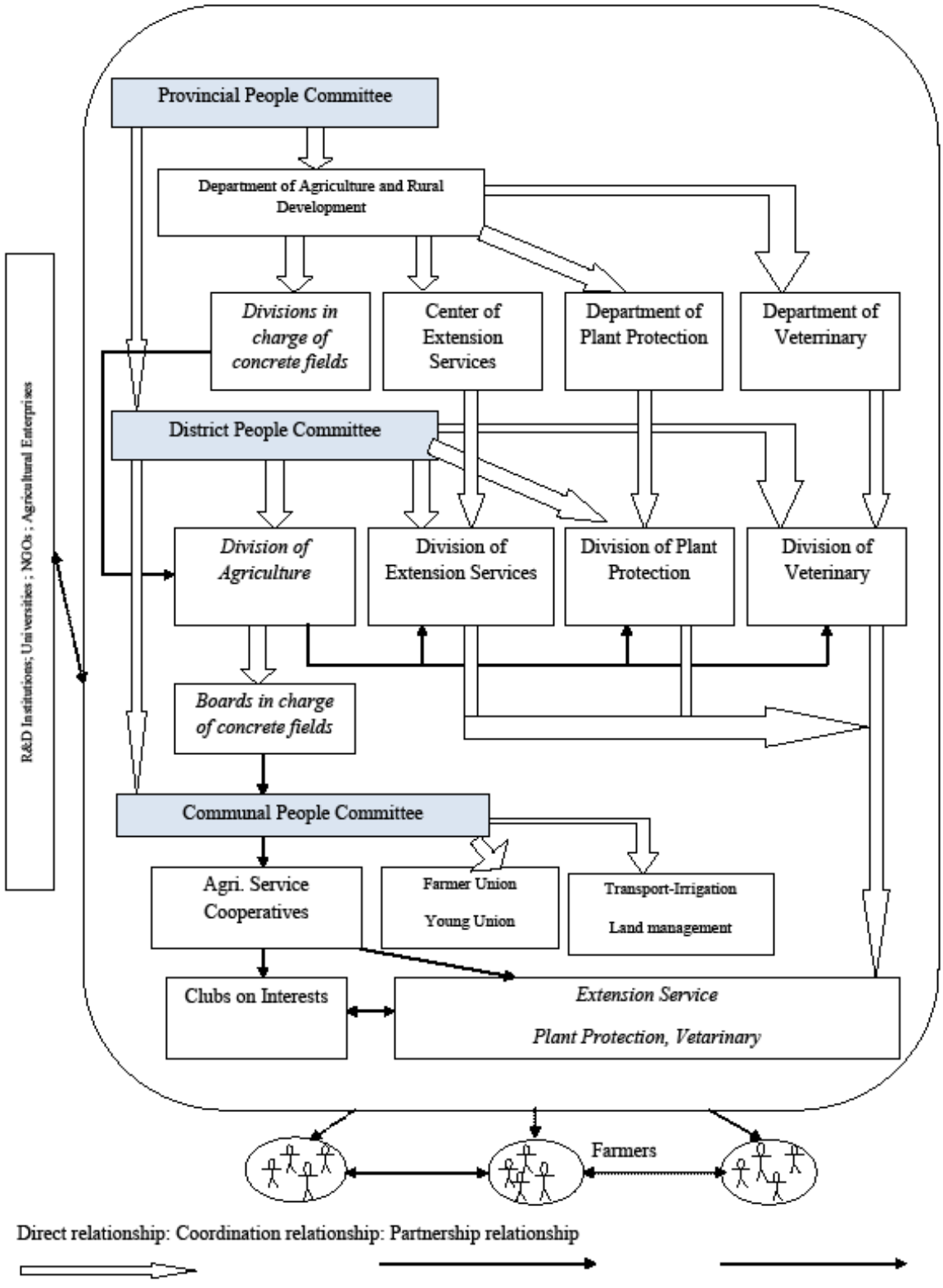


Figure 5.5: Overall view of the local system in transferring innovations to farmers

Source: Own compilation.

- The second flow is conducted by the DOST. Related typical operations consist of the implementation of specific programs to transfer technology to farmers in the rural areas or the provision of incentives for scientist and R&D organisations to establish co-operation with farmers. For these operations, the program of technology transfer to farmers in the rural areas is similar to socio-economic programs carried out by the DARD, however, mainly focusing on technical issues. The second operation of providing incentives is considered as providing a favourable environment and indirect impact for transferring S&T's achievement to farmers.
- The third flow is dominated by R&D organisations where the transfer of technologies may occur under the impact of profit intention, or orders from state agencies, or due to incentives, and so on. The last flow is discussed on many forums regarding the more involvement of scientists in agriculture and rural areas. Of course, R&D institutes, universities, NGOs, Agricultural Enterprises may have many other functions, but they are considered as farmers' partners with regards to their function of providing technological innovation and solutions for farmers.

These organisations might contact farmers in a structured plan following to top-down approach or in a way of managed by market mechanism. That means partners may directly communicate with farmers or through the above official system to remain in touch with farmers to diffuse innovations. But all above relations should be in conformity with the regulations from state administration. Currently, a set of policies has been made available in the form of guidelines which provides support for organisations as how to transfer of innovative advancement to farmers and how to create a favourable environment for doing such works. However, are these policies enough to regulate the relations between the organisations or behaviour of all partners? The answer to this question will be considered in the following sections through an examining the evaluation of farmers and experts in followed topics.

5.2. Capability of farmers in receiving and applying agricultural innovations

Farmers are the focal target of all policies supporting the transfer of S&T's achievement. They act as targeted beneficiaries for these policies, or as consumers participating actively in requesting S&T's achievement for their production. Simply, farmers are considered as the last link in the chain of transferring S&T's achievement from creators to users.

Therefore, the indicator of consumer's acceptance and their behaviour plays a vital role in the evaluation of efficiency of the process of transferring such innovations to farmers. As such this assumption has been used:

Assumption: The characteristics (endogenous/subjective factors) of farmers might impact the process of transferring and applying S&T's achievement in agricultural production of farmers. This factor might positively support for the process or limit the efficiency of the process.

The subjective factors include the educational level of farmers, age (health) of farmers, the economic wealth of households as well as the behavioural characteristics of farmers (which are considered as endogenous factors).

5.2.1. The educational level of farmers

Table 5.1. The distribution of interviewed farmers by educational levels

		Educational level of the interviewers				
		Simple reading, writing and calculating	Graduated Primary school	Graduated Secondary school	Graduated High school	Total
Haiphong	Count	3	7	17	7	34
	% within location	8.8	20.6	50.0	20.6	100.0
	% of Total	3.5	8.2	20.0	8.2	40.0
Thaibinh	Count	1	4	8	10	23
	% within location	4.3	17.4	34.8	43.5	100.0
	% of Total	1.2	4.7	9.4	11.8	27.1
Hungyen	Count	6	5	10	7	28
	% within location	21.4	17.9	35.7	25.0	100.0
	% of Total	7.1	5.9	11.8	8.2	32.9
Total	Count	10	16	35	24	85
	% within location	11.8	18.8	41.2	28.2	100.0
	% of Total	11.8	18.8	41.2	28.2	100.0

Source: Data is collected from the own survey in 2009.

Knowledge is the basis of all recognition of human, including awareness of applying innovative advancement in agriculture. In this section, I assume that the educational level

of farmers is proportional to the application of innovative advancement in agricultural production.

In total 85 farmer households were analysed in the survey of the three provinces, including 34 households in Haiphong, 23 households in Thaibinh and 28 households in Hungyen, in which most of the 'heads of the household' are qualified as having a high level of education. The survey's data has revealed that 41.2% of interviewees had graduated from high school, 28.2% had graduated from secondary school and a fraction (11.8%) was able to read and write.

Box 5.1. The model of orchid production in Hungyen province

Xuanquan is a district belonging to Hungyen province. It locates next to Hanoi, the capital of Vietnam where farmers may explore a huge potential market for many agricultural products. In this district, the traditional agriculture of growing bonsai and flowers is very popular.

In late 2009, recognizing that orchid for Tet festival (in the first three day of a new Lunar calendar year) would be a valuable product for market demand for earning a lot of profit, some families initially specialized in ornamental flower production has shifted to invest in orchid production. Ms. Diep was one of these farmers. Engineering, technical care and other inputs such as seeds, fertilizers, plant baskets, technological equipment are transferred from the Hanoi Agriculture University in combination with her family-owned experience. With a total investment of 50 millions VND in her orchid garden, after a period of 10 months she has gained 100 millions VND. She said that the application of innovative advancement is the decisive factor in the success of her story.

Ms. Diep and her husband have already graduated from high school, were born in traditional gardeners families in Hungyen.

Source: Data is collected from interviews in 2010.

In three provinces, Thaibinh province has the higher educated farmers out of those provinces, within the four classified levels respectively of fluent reading and writing (4.3%), graduated from primary school (17.4%), graduated from secondary school (34.8%), and graduated from high school 3 (43.5%). On the other hand Hungyen is the province where the educational levels of interviewed farmers are at their lowest, 21.4%, 17.9%, 35.7% and 25%.

Table 5.2. Distribution of farmers following to their income in 2009 and educational level of the head of household

Total income of household in 2009 Mil. VND	Educational level of the head of household				Total
	simple reading, writing and calculating	Graduated Primary school	Graduated Secondary school	Graduated High school	
3 - 18	2	1	7	3	13
20 - 25	2	4	8	3	17
30-40		7	8	3	18
50-60	4	2	10	6	22
70-80		2	2	4	8
81.00				1	1
96.00				1	1
100.00	2			2	4
135.00				1	1

Source: Data is collected from the own survey in 2009.

The survey data reflects the fact that the situation of applying innovative advancement in Thaibinh province is homogeneity and transparency, while the situation in Hungyen province is relatively different, especially between the households with different levels of education. The success of applying agricultural innovations in production in Hungyen is mainly occurred when the farmers are highly qualified whilst the remaining farmers apply innovative advancement at a moderate level as recommended by local extension services and local administrative agricultural agencies (district level). When considering the impact of education on incomes of households, data shows that the households whose head of household's has the highest level of education (graduation from high school) earned more (135 million per year, 2009 figures) than those with a lower educational level (30 to 80 million VND income per year, 2009 figures). Only a few households were seen to achieve a high-income with a lower educational level (see table 5.2). In most of these households, farmers were typically in robust health, had a strong willingness of adapting to new things or they had a rich experiment in production.

Thus, whether education will improve chances for farmers getting higher income or not? In order to examine the differentiation of educational levels of farmers in relation with sources of income, the data from table 5.3 was analysed, this reveals that there is a

significant difference in educational levels of farmers in cases of non-agricultural sources, while the differentiation is remarkably little in cases of agricultural sources. As such the more qualified the farmers are, the more chances are available for them to get income from outside agriculture. At the lowest level of basic reading/writing, there are only 2 cases (2.4% of total interviewees) that were able to earn money from non-agricultural operations, whilst there were 8 cases (9,4% of total) with farmers who had the highest level of education. The difference is 4 times (8/4) in comparison with 1.75 (equal to 14/8) times, in cases of income comes from agricultural sources. According to collected information, the sources of income for farm households are diverse, from working in local industrial firms, or conducting non-agricultural services. These activities might bring greater chances for farmers to get higher income, but also require farmers to respond quickly to seize business opportunities as well as sufficient knowledge to meet the requirement of employers in recruitment. Thus, enhancing educational levels of farmers not only promotes the application of innovative advancement but also provides chances for farmers to gain a higher income from all other activities.

5.2.2. Training levels of farmers

The survey showed that there are relatively few certified, trained farmers within the RRD. The number of people who had been granted certification was only 3, accounting for 3.5% of the total. However, instead of having certificates in agricultural related topics, these farmers were trained in accounting and administrative management. The result is understood when the official vocational training on providing agricultural skills is not available. De facto, farmers operate their farms mostly by personal experience with in-continuous support through short training courses organised by extension services, or obtaining information from mass media channels, or learning through other channels. Moreover, the operation of modern commodity agriculture requires farmers to get professional knowledge systematically, not only from certified training courses but also from other forms of decentralised training, in which full-time vocational training should be considered as the one of very important form. In addition, the forms of lifelong learning and learning-by-doing should be taken into account with the support of modern media facilities. These activities allow opportunities for farmers to think about applying innovative advancement in their agricultural production.

Table 5.3. Distribution of farmers following to their major sources of income and educational level of the head of household

Major sources		simple reading, writing and calculating	Graduated Primary school	Graduated Secondary school	Graduated High school	Total
Agricultural production	Count	8	11	21	14	54
	% of Total	9.4	12.9	24.7	16.5	63.5
Service for agriculture	Count		1	3	2	6
	% of Total		1.2	3.5	2.4	7.1
Wages monthly from non-agricultural production	Count	2	4	11	8	25
	% of Total	2.4	4.7	12.9	9.4	29.4
Total	Count	10	16	35	24	85
	% of Total	11.8	18.8	41.2	28.2	100.0

Source: Data is collected from my own survey carried out in 2009.

Box 5.2. Farmers and learning process

"In discussions with farmers, most of them agreed that their farming has undergone several generations and draw thousands of years of experience, thus without a vocational training, they do know how and what is necessary to operate their farms. However, when they apply new agricultural techniques, many of them has proved their embarrassing and often implement basing on their owned knowledge empirically, leading to incorrect as compare to technical guidance, and consequently, the outcome would not be high as expected. Farmers need to change their perception of this recognition, and the state should support for the learning process. According to Mr. A , the Division of Agriculture in Hungyen province

Source: Data is collected from the own survey in 2009.

Thus, the indicator of educational level and training level affects the effectiveness of the application of innovative advancement in farmers' agricultural production. However, the behaviour of farmers in applying S&T's achievement is certainly a result of a decision-making process of individual households, which is impacted by many other factors, for example, their willingness to innovate, their facility, their financial capability, health, their own land, and so on, is usually proportional to the level of innovations applying. Within

the social infrastructure in Vietnam today, the state has invested a lot in education; however, vocational training still requires more attention. Vocational training provides professional knowledge in a more systematic way, placing much more emphasis on training subjects and professional subjects, as well as providing trainees with a more professional perception. For example, trainees not only master the knowledge gained from vocational training, but they also understand how to develop that knowledge systematically, as well as searching for information about suppliers which without training they might not know about. As such, more attention should be paid to education and vocational training within Vietnam.

5.2.3. The age of agricultural labourers

The labour force within agricultural system and within rural areas is currently undergoing a tremendous restructuring process. This is due to population ageing and the migration of agricultural workers to other industries. According to the survey data, 46% of the total heads of the household in the survey were aged 55 or older. At these ages, it becomes more difficult to carry out hard works on the fields. However, because of the special nature of agricultural production to concentrate only in seasonal activities, other family members (e.g. children, husbands or wives) can temporarily stop their usual work to participate in agricultural production and support their families. After these activities have been completed (this happens several times a year and lasts only about 1-2 weeks), they return to their previous work. Today, some of the extremely heavy work, for instance, soil preparation, transplanting, harvesting and processing is carried out mainly by machines. This has freed up farmers enabling them to participate in other non-agricultural activities. However, in order to use these machines and modern equipments, the older people appear to be slower and less receptive than young people. This is also a problem in the process of applying modern production process with new objects. Thus, the quality of farmers in terms of occupational skills and labourer's capacity certainly affect the efficiency of labour as well as efficient use of modern tools in production. Providing occupational skills through training for farmers is a topic of interest. As such the productivity of labourers increases along with the application of new technologies, especially within the field of agricultural engineering and irrigation.

The survey shows that (Figure 5.6), there are 60 households, accounting for 70.59% of the total, getting income mainly from agricultural production and services. The remaining 25

households, accounting for 29.41% of the total, mostly get their income from outside non-agricultural sources.

The farmers whose income comes mainly from non-agricultural sources can also divided into two groups based on their ages, in which the first group is 50 years old and over, and the second group is 49 years old and under.

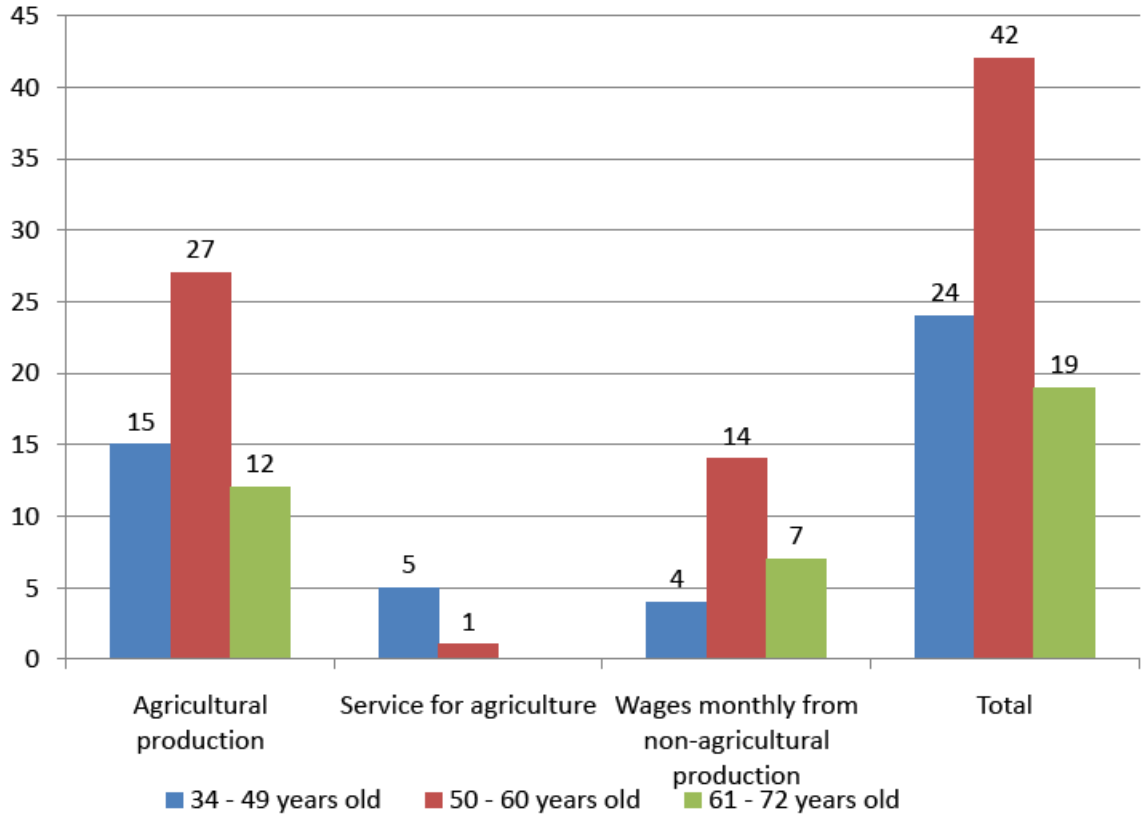


Figure 5.6: Relation between "age of head of household" and "major income of household"

Source: Data is collected from the own survey in 2009.

The first group of farmers (aged of 50 and over) account for a major proportion of the total number of farmers surveyed (14 + 7 = 21 farmers, accounting for 84% of total farmers who have income mainly from non-agricultural activities, showed in Figure 5.6). This group includes mainly farmers who are receiving a pension, or salaries and allowances for time served in military or state agencies. As such these farmers generally work in the agricultural sector to generate additional income for their families as a supplement to their pension. Agriculture is not seen as an important focus for these farmers. In addition, income from agriculture is not high in comparison with other sources. Further, farmers have to contend with waiting a long time for returns on money they have invested, risk of

natural disasters, market risks, hard work, which is unsuitable for elderly farmers. As such this does not encourage these farmers to have a strong invest in agriculture. Although these farmers are highly qualified with rich experience not only within the agricultural sector but also of life, their investment in applying innovative advancement in agriculture is still modest. Normally it is just enough for common basic items such as seed and fertiliser. Their application of innovative advancement is based much on the guidance of extension staff and local authorities.

Table 5.4. Distribution of farmers analysed by Age of farmers, Major income of household and Total income of household in 2009

Total income of household in 2009	Average Ages	Major income of household			Total
		Agricultural production	Service for agriculture	Wages monthly from non-agricultural production	
3 - 6	65	3			3
10 - 18	56.30	10			10
20 - 25	50.53	14	1	2	17
30 - 36	56.07	12		2	14
40 - 50	51.68	12	2	5	19
55 - 60	54	1		6	7
72,00	61			1	1
80 - 81	54.87	1	2	5	8
96-100	54	1	1	3	5
135,00	49			1	1

Source: Data is collected from my own survey carried out in 2009.

The remaining group of farmers aged 49 and under accounts for four farmers (see Figure 5.6). They work in an industrial area, or local handicraft firms, alternatively they are also hawkers when they immigrate to cities during the lull periods in the agricultural sector. However, these farmers only undertake this type of work if they live in a region near to an industrial area, big cities, or in the region where handicraft is available and developed. These farmers are characterised as being highly educated or young. They are also generally

active in searching for opportunities to earn more money. For those people working in industrial areas, education is particularly beneficial as they are requested to prove their educational ability and it allows these farmers an opportunity to earn a higher income.

Data in table 5.4 shows that most of the farmer households are earning on average an income of about 20-50 million VND per year, where the head of household is aged between 50 to 56. The younger heads of households (those aged 49 and under) earn a better income (135 million VND per year), but the income does not come from agricultural production. The oldest farmers over the age of 65 earn only between 3-6 million VND per year from just agricultural production. This result reinforces the idea that in order to get a high income, farmer should invest in other activities outside agriculture. In addition before doing that, they must be equipped with sufficient knowledge and skills as well as an opportunity to of setting up a business. Farmers within the younger age group would support for this process; however, those in the older groups are likely to constrain this procedure.

Table 5.5. Crosstabulation among Age of farmers, Educational level of the head of household and Total income of household in 2009

Total income of household in 2009		Educational level of the head of household				Total
		simple reading, writing and calculating	Graduated Primary school	Graduated Secondary school	Graduated High school	
3 - 6	65		1	2		3
10 - 18	56,30	2		5	3	10
20 - 25	50,53	2	4	8	3	17
30 - 36	56,07		7	5	2	14
40 - 50	51,68	4		8	7	19
55 - 60	54		2	5		7
72	61				1	1
80 - 81	54,87		2	2	4	8
96-100	54	2			3	5
135,00	49				1	1

Source: Data is collected from the own survey in 2009.

Data in the table 5.5 also shows this to be the case as the youngest farmer who earned the highest income in the survey graduated from high school, which is the highest level of education within the survey. On the other hand, although some of farmers with appropriate educational levels (primary school and secondary school) their income is still at the lowest levels of only 3-6 million VND per year. These farmers are all aged between 54 to 65 years. This result has revealed that the condition of farmers' health could have impacted on their income.

5.2.4. Gender issues

Table 5.6. Crosstabulation between Educational level of the head of household and Gender of the head of household

Educational level of the head of household		Gender of the head of household		Total
		Male	Female	
simple reading, writing and calculating	Count	4	6	10
	% of Total	4.7%	7.1%	11.8%
Graduated Primary school	Count	10	6	16
	% of Total	11.8%	7.1%	18.8%
Graduated Secondary school	Count	17	18	35
	% of Total	20.0%	21.2%	41.2%
Graduated High school	Count	18	6	24
	% of Total	21.2%	7.1%	28.2%
Total	Count	49	36	85
	% of Total	57.6%	42.4%	100.0%

Source: Data is collected from the own survey in 2009.

Analysis of the relationship between gender and educational level in table 5.6 shows that there is little difference between the numbers of men and women at primary school. At the higher levels, the percentage of men increases while the percentage of women decreases. For example, at the levels of compulsory education, the numbers of educated men compared to women is 51% and 49% respectively, whereas at the high school level, the numbers are 75% and 25%. The limitation in education for women has restricted the recognition and understanding of rural women, and affected the process of recognising innovations and mastering them in the farm work. According to gender approaching,

encouraging and supporting women farmers to achieve higher levels of education should be highly recommended.

Analysis of the role of women in their family showed that they are not inferior to men, 42.4% of all heads of household (36 respondents) are female, and the remaining 57.6% (49 respondents) are male. This fact is much different from the traditional rural society in RRD region before, when the head of farmers' families in rural areas were often male. The increasing importance of women's roles in farmers' family is a basis for setting up gender approach in transfer innovative advancement to farmers in the region. Using gender approach would diversify the ways to approach farmers, or improve the efficiency of innovations in the region.

Picture 5.1. Female labors on the field.

Source. Own photo.

Examining the distribution of farmers' income using the indicator of gender, data in table 5.7 reveals that there is a significant difference between the incomes of male and female farmers, including income from outside agriculture. Men (19/49 = 39%) tend to earn money outside agriculture in comparison to women (6/36 = 17%). This data reflects a

social reality in rural areas as the role of men is always considered as more influential than women. In traditional agriculture, men usually have a decisive voice in determining what happens, because they are the backbone of the family labour. In a traditional rural society, men hold higher positions of responsibility; and participate actively in social activities.

Table 5.7. Relationship between "Gender of the head of household" and "Major income of household"

Gender of the head of household	Major income of household			Total
	Agricultural production	Service for agriculture	Wages monthly from non-agricultural production	
Male	31.8	3.5	22.4	57.6
Female	31.8	3.5	7.1	42.4
Total	63.5	7.1	29.4	100.0

Source: Data is collected from the own survey in 2009.

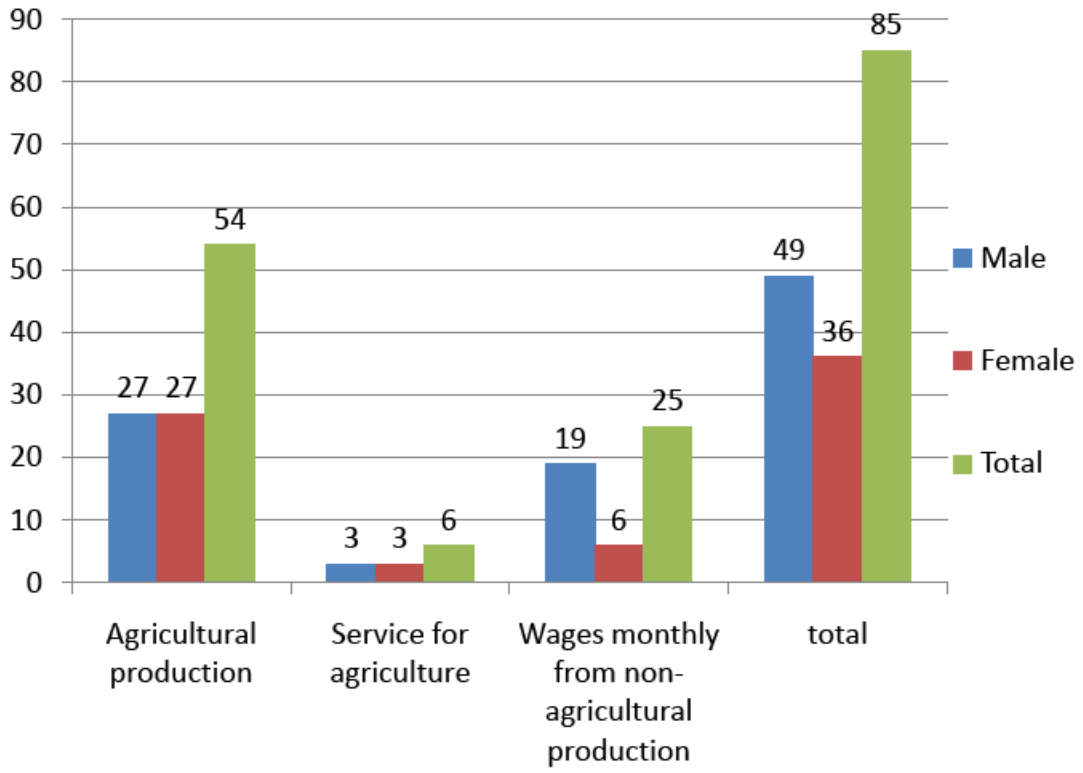


Figure 5.7: Relation between “Gender of the head of household” and “Major income of household”

Source: Data is collected from my survey conducted in 2009.

They have more opportunities to access education, training services and job opportunities. However, when men leave the agricultural sector, women take their place and play as a decisive force to change the productivity and agricultural output. Survey data also shows that the number of women who are the head of household is quite high (36/85 respondents, accounted for 42.4% of total households in Figure 5.7 and table 5.7). Therefore, the transfer of innovative advancement should take the gender issues into account. In practice, women's associations, in addition to other unions, associations and clubs play an active role in social activities. For women, their association is a forum where they can express their voice, themselves and exchange their experience in production as well as in life. Access to rural women through their organisation or their forum would be an effective way to transfer innovative advancement.

5.2.5. Labour capacity and human resource in agriculture

Considered as one of the subjective factors affecting the application of innovative advancement in agricultural production, the potential of labour and household's population are two factors, which show the internal capacity of household.

According to survey data (Table 5.8), the average number of people per household is 4.32, in which there are on average 2.6 full-time workers and 1.53 part-time workers per household respectively. Whereas the average amount of land, owned per household is 2,531m2. This figure reveals the type of small-scale production and labour intensive agricultural production that is used in the region. In the near future, when modernisation in agriculture is likely to become an unavoidable trend (where new machinery and modern tools would be applied in production to save time and labour), it is likely to result in a surplus of agricultural labour. The abundance in labour capacity has advantages and limitations for households. For an efficient use of this surplus labour, not only the encouragement to shift this labour into other non-agricultural sectors, but also the utilisation of new technologies which are labour intensive is required. Therefore, in cases of similar efficiency, labour intensive technologies should be recommended than others. In the survey, 62/85 households (accounting for 73%) had between 4-8 people per household. The household with from one to three people were only being poor single elderly, or new families for example a newly couple and a young child. In fact, having fewer people per household has restricted the chances for households to earn especially an income from non-agricultural activities. The households with a higher number of people might get more income from off-farm sources. As the amount of agricultural land, allocated to each

farmer's household, is limited for the households with an abundant source of labour, they have to search for other non-agricultural opportunities to supplement their income. In a contrast, the household whose population is quite small, they may not satisfy the requirements of non-agricultural recruitment (for solitary households elderly), or agricultural works take up all their time and they cannot assign time for non-agricultural work, for example, for young families with young children.

Table 5.8. Distribution of surveyed cases by "Total population of household" and "location"

Total population of household		Location			Total
		Haiphong	Thaibinh	Hungyen	
1	Count		2		2
	% of Total		2.4%		2.4%
2	Count	4	2	1	7
	% of Total	4.7%	2.4%	1.2%	8.2%
3	Count	3	4	7	14
	% of Total	3.5%	4.7%	8.2%	16.5%
4	Count	8	10	10	28
	% of Total	9.4%	11.8%	11.8%	32.9%
5	Count	11	2	4	17
	% of Total	12.9%	2.4%	4.7%	20.0%
6	Count	4	2	3	9
	% of Total	4.7%	2.4%	3.5%	10.6%
7	Count	4		2	6
	% of Total	4.7%		2.4%	7.1%
8	Count		1	1	2
	% of Total		1.2%	1.2%	2.4%
Total	Count	34	23	28	85
	% of Total	40.0%	27.1%	32.9%	100.0%

Source: Data is collected from my own survey conducted in 2009.

Analysis of full-time labour and part-time labour of farmers' households show a fairly vivid picture of migrant labour in agriculture of the region. Generally, immigration takes place under the influence of the following factors:

- Differences in income
- Employment opportunities
- Pressure-subsistence livelihoods
- Access to social services
- A gap in the development of infrastructure

Table 5.9. Descriptive statistics of labour of farmers' household

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Total population of household	85	1	8	367	4.32	1.506
Numbers of fulltime labors	85	0	6	221	2.60	1.255
Numbers of part-time labors	85	0	5	130	1.53	1.306
Valid N (list wise)	85					

Source: Data is collected from my own survey carried out in 2009.

Although migration is a socio-economic phenomenon, which has an unavoidable nature and is an inevitable outcome of having a market economy it also is a manifestation of the uneven development between regions and economic sectors. The studies of migration in Vietnam have shown that the typical migration is temporary or seasonal labour migration. The nature of this migration is the utilisation of labour in the lull period where people move temporarily to other regions and other sectors for a short period, and then return to agricultural production during the harvesting. In fact, the part-time nature of farmers' households is mainly formed due to seasonal migration. This form is quite common in rural areas close to large cities. In these areas, labour does not detach entirely from agriculture but only participate in critical stages of production; therefore, they do not pay enough attention to agricultural production for the whole period, and this certainly influences the attention applied to innovative advancements in agricultural production. However, from a different perspective, the migration of labour during the lull periods has provided an alternative income for workers adding to the already meagre income from agriculture. In many cases, the interviews showed that this "added" income has helped farmers to invest in basic inputs such as seeds, fertilisers which includes advancements in agricultural production, in the context of capital requirements, often stress concentration in the initial stage of the crop. Considering the aspect of investment for innovation, such

investment is only at a simple level. Thus, seasonal labour migration has both negative and positive influences in the application of S&T's achievements. However, this influence would not lead to a robust application of innovative advancement in agriculture.

Table 5.10. Numbers of part-time labourers by localities

Number of partime laboures	Location			Total
	Haiphong	Thaibinh	Hungyen	
0	10	5	7	22
1	10	4	7	21
2	7	13	7	27
3	5		4	9
4		1	1	2
5	2		2	4
Count	34	23	28	85
% of Total	40.0%	27.1%	32.9%	100.0%

Source: Data is collected from the own survey in 2009.

Out of the total 85 households surveyed, there were 63 households whose labourers were part-time, representing 74% of the total (Table 5.10); the type of seasonal part-time labour due to migrant labour is significant. Although this figure does not impact directly on the implementation of innovation, but it might lead to the failure in satisfying the requirements of applying innovations in households' production. In the survey, a number of interviewees stated that because they do not have enough labour, time and budget for agricultural activities they would not be able to apply new production processes, or using new varieties in their households' production. This also proves that only when farmers are fully focused in respect of time, effort and resources on considering agriculture as the main source to bring income and prosperity to the household then innovations are applied. Thus, diversifying the types of work and creating jobs in the rural areas would be reasonable measures to exploit the surplus labour within the agricultural sector. The development of modern, large farms with intensive investment in agriculture in the rural areas, where demand for labour is relatively high should be considered as one specific solution for this problem.

5.2.6. Income structure of farmers' household and its impact on the application of innovative advancement

Analysis on the structure of households' income shows that not all farmers' income is from agriculture. Table 5.11 shows there is up to 25% of households whose income from agriculture only accounts for 10-40% of the total households' income. In addition, only 14% of households said that their income is 100% from agriculture. This figure is equivalent with evaluation of farmers about their sources of income as mentioned in the analysis from data in table 5.3.

Table 5.11. Percentage of income from agricultural production by locations

Percentage of income from agricultural activities (%)		Location			Total
		Haiphong	Thaibinh	Hungyen	
10-30	Count	11	3	5	19
	% of Total	13	3.6	5.9	22.5
40-60	Count	10	8	12	30
	% of Total	11.8	9.4	14.2	35.4
70-90	Count	10	6	8	24
	% of Total	11.7	7.1	9.5	28,3
100	Count	3	6	3	12
	% of Total	3.5	7.1	3.5	14.1
Total	Count	34	23	28	85
	% of Total	40.0	27.1	32.9	100.0

Source: Data is collected from the own survey in 2009.

In three surveyed provinces, Thaibinh is the province where agriculture is the main source for income of farmers, (Table 5.11) where 52.17% (13/23) of total farmers' households in this province have the revenues from agriculture accounted for 70-100% of household income. However in Haiphong and Hungyen it only accounted for 38.24% (13/34) and 39.29% (11/28) respectively. In other words, the number of households with the lowest proportion of agricultural income in Haiphong is highest (there are 11 households in Haiphong whose income from agriculture is accounted only 10-30% of household income), and in Thaibinh is lowest (only 3 households).

Thus, the survey shows the differentiation in agricultural density in various localities within the RRD. In these regions, the proportion of agricultural households (42.35% 36/85)

whose income from agriculture makes up between 70-100% of the total income. This number should be taken into account during policy decision making processes and provide feedback to encourage the application of innovative advancement in agricultural production in the delta. These figures highlight that agriculture is still quite beneficial to the region (14.1% of households said that 100% of their income comes from agriculture). Despite these other economic sectors are also relatively well developed in the region, enabling farmers to diversify sources of income. In this context, developing a modern agriculture, highly specialised and focused towards commodity production, is necessary. In addition, when agricultural development in harmony with economic sectors it will allow the sustainable development of the region to occur.

Table 5.12. Statistical number of farmers in the relation between Total income of household in 2009 and Percentage of income from agricultural activities

Mil. VND		Percentage of income from agricultural activities													Total
		10	20	25	30	40	50	55	60	70	80	85	90	100	
Total income of household in 2009	3-6													3	3
	10-18						2		2	2			1	3	10
	20-25				2		5	1	2	4			2	1	17
	30-36		2						2	3	3		2	2	14
	40-50	1	2		3		5		4	3	1				19
	55-60	1		2	2				1				1		7
	72.00				1										1
	80-81		2			2	2				1			1	8
	96.00				1										1
	100.00								2					2	4
	135.00											1			1
Total		2	6	2	9	2	14	1	13	12	5	1	6	12	85

Source: Data is collected from the own survey in 2009.

In the distribution of agricultural income of farmers' by sector, the number of households whose income is mostly from cultivation is 48/85 or 56.5% of the total households, whereas the livestock accounts for 11/85 or 12.9% of the total. Furthermore, there were 26/85 (30.6 %) households, which had an income from a mix of cultivation and livestock. Examining the values of their income, the cultivation households achieved the lowest revenue whereas the farms which had a mix of cultivation and livestock households, had

the highest income, with the income from livestock falling in between. In fact, the mix households take advantage of the strengths of cultivation and animal husbandry to complement each other. For example, animal waste is used as organic fertiliser for plants and other supplemental products of cultivation could be used as food for livestock. However, specialising on cultivation, livestock or having a mix between the two does not only depend on the personal preferences of farmers but also on the conditions, capabilities and expertise of the households. With the average agricultural area per person becoming increasingly limited, the development of cultivation has been more circumscribed. Furthermore, the high population density and inability to convert arable land for other purposes in coupled with the large amount of capital requirements for investment have also limited the development of livestock. In addition, the risks of uncontrollable diseases and from the unpredictability of the market have also restricted the development of the livestock sector. Potential solutions for these problems could be planning in conjunction with generating opportunities for farmers to approach capital investment and strongly support of knowledge, market information, disseminating efficient models.

Picture 5.2. At a typical farmer's house

Source. Own photo.

In the survey, the household with the highest income (135 million VND per year) is a mixed production household, in which 85% of their income came from agricultural production (Table 5.12). In this case, the farmer took the strengths of their production in cultivation, livestock and their supplement production. Furthermore, they were active in applying innovation for new products such as super-lean pigs, ducks for super eggs, high-quality rice, plus the agility of market information to make their products at high productivity, best quality and best prices. Many households in the locality have observed and adopted these experiments, and they all agreed on the effectiveness of these measures. Examining the relationship between the ratio of income from agriculture and the income levels of households shows that most of the agricultural households (whose income from agriculture is a significant part of households' income) have a low income. However, many households, which have a high income overall, only get a small proportion of their revenue from agriculture. Despite this, there are still many households who achieve a high income from agriculture. For instance, at an income of over 100 million VND/household/year, this type of household is 5/85 households, accounting for 6% of the total. In fact, these five households were active in applying innovative advancement in their production. This figure could reveal that if farmers focus on their agricultural production intensively using different measures applying innovations with the efficient support of extension services, they would achieve greater success in their production.

5.2.7. Land possession of households

In the 85 surveyed households, on average each ones owns 2,351 m2 of agricultural land, in which 2,071 m2 is arable land on the field, 242 m2 garden and 18 m2 cage. The most amount of land-own is 4,320 m2, while the smallest acreage is only 500 m2. For arable land, the largest area of one household is 3,600m2, while the smallest area is 500m2. Similarly, the figures of garden are 1080 m2 and 0 m2, areas of cage are 150 m2 and 0 m2.

Currently, agricultural land in the region is fragmentary, and this is a result of the equal allocating agricultural land to farmers previously. According to the Law of Land use issued recently, although the land use rights of farmers have been implemented through the law for 20 years for the annual crops' land and water surface, and 50 years for forest land, the fragmented nature and small size of land has caused significant difficulties for utilising mechanical machinery in production. Furthermore, it has also created difficulties in applying innovative advancement in production. Moreover, these distinctive small pieces of land belonging to different families in a comb set on the field sometimes are

inconsistent with planning, cropping systems, farming techniques, pest control, and so on, resulting in the limitation in the productivity of each piece of land.

Table 5.13. Land areas for cultivation on the field

M2	Frequency	Percent	Valid Percent	Cumulative Percent
500-820	3	3.6	3.6	3.6
1080-1440	10	18.9	18.9	22.5
1620-1980	24	28.3	28.3	50.8
2000-2200	13	15.3	15.3	66.1
2260.00	2	2.4	2.4	68.5
2520.00	11	12.8	12.8	81.3
2700.00	2	2.3	2.3	83.6
2880.00	7	8.2	8.2	91.8
3600.00	7	8.2	8.2	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

Measuring the frequency of households by scale of land use shows that the majority of households (66.1%) have an area of agricultural land in between 1080 - 2200m2 (which accounts for 47/85 respondents). The number of households without garden is 32/85 cases while in 17 cases their gardens are approximately 300 - 360m2. The number of households without cages is 49/85 while there are 16 cases whose cage areas were between 15-30 m2.

Box 5.3. Damages caused by unnoticeable neighbour

Mr. A and Mr. B have two pieces of adjacent land. Mr. A grows cucumber while Mr. B grows maize. Cucumbers and maize are two crops with different growing time with different fertilization as well as different methods in pest control. Therefore, when Mr. B spraying pesticides for maize, while cucumber is in the harvest period, then flying pests from maize fields has shifted to cucumber fields causing to damage of Mr. A. A story in Thaibinh.

Source: Data is collected from the own survey in 2009.

With such a wide range in the amount of land ownership, farmers can only carry out production on the small-scale and the proportion of commodity products per household is not high. Land size has revealed the small-scale production of most farmers in the region.

Due to limitation of small-scale production, in a normal agricultural production, the results are not high enough to attract farmers investing in innovative advancement, except the common things as seed, fertilizer, pesticide. In some cases, farmers give up agriculture altogether as such they lend their land to other relatives without or at low cost.

Table 5.14. Areas of garden

M2	Frequency	Percent	Valid Percent	Cumulative Percent
.00	32	37.6	37.6	37.6
15-50	3	3.6	3.6	41.2
100-240	16	18.8	18.8	60.0
300-360	17	22.3	22.3	82.3
440-540	2	2.4	2.4	84.7
660-720	9	10.6	10.6	95.3
1000-1080	4	4.7	4.7	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

Picture 5.3. Small pieces of paddy-rice growing fields.

In contrary, the limitation of land resource is also setting challenges for active farmers and some of them have found a solution to overcome this difficulty. They search for a favourable model of production for their land, whereby a lot of their investment pays for innovative advancement. In these cases, farmers have been known to combine their experiments with modern techniques, catch the market chance, and known how to exploit the information. Their understanding, their relation and their willingness in developing the agricultural techniques for their farm are the core to their success. In fact, these farmers have a close relation with other innovative forces from outside their villages.

Thus, to enhance the application of S&T achievement in agriculture, on one hand an attractive application appropriate to local demand needs to be created and on the other hand, creating a learning environment for farmers to exchange their experiments, their resources, their way of conducting production and even creating T&V models in rural areas would be valuable solutions for these issues. Furthermore a set of supporting policies within the building rural infrastructure, information systems of S&T, extension services, credit and financial support policy sectors would also be highly beneficial.

Table 5.15. Areas for livestock

	Frequency	Percent	Valid Percent	Cumulative Percent
.00	49	57.6	57.6	57.6
6-15	7	8.3	8.3	65.9
20-40	15	17.6	17.6	83.5
50-72	10	11.7	11.7	95.3
100-150	4	4.8	4.8	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

To overcome the fragmentary of land in Vietnam, the government has encouraged households to consolidate small plots of land into larger fields, based on the agreement and willingness of involved farmers. Although the results of this program have not been 100% successful, initial results show the greater efficiency of large plots in production. Farmers in rural areas have gathered in groups to discuss the matter of exchanging their own land for bigger plots instead of scattered small parcels of land. In this discussion, the inherent characteristics of the farmers influenced the outcomes of these exchanges. However, the largest plot is limited to a maximum of 2000m2 per a household. Such scale is a significant

difficulty for a modern production, as such farmers have to look for a proper production model where innovations such as new seeds, efficient fertiliser, suitable plants and animals, improvement in quality and productivity would be relevant issues.

In addition to this the authorities have also encouraged the collection and gathering of agricultural land at a reasonable level without causing serious social conflict. The land accumulation process can take many forms such as converting, leasing, bidding, reclamation of land to consolidate land to create large farms can enable farmers to conduct large scale production. Concretely, land size is a fundamental criterion in building a model farm economy. As a rule , the models of farm could include a variety of farms as cultivation farm, livestock farm, forestry farm, aquaculture farms, mixed farms and each of them must have a minimum scale of land area over 2 hectares (cultivation farm, livestock farm, aquaculture farms, mixed farms) and over 30 hectares (of forestry farms) for the RRD. The model of farms is the best conditions for the application of new S&T into production.

5.2.8. Investment in facilities for production

In order to evaluate the investment of farmers in equipment and tools for their production, self-evaluation questions on the four types of facilities relating to preparation work, facilities for meantime production, facilities for harvest work and facilities for post harvesting were examined.

Table 5.16. Self-evaluation on equipment of household for preparation work

	Frequency	Percent	Valid Percent	Cumulative Percent
under equipped	6	7.1	7.1	7.1
acceptable equipped	44	51.8	51.8	58.8
well equipped	35	41.2	41.2	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

According to their own evaluation, farmers are mostly satisfied with their own systems of equipment and tools and in some cases they did not know how to invest to improve their facilities. These are the cases whose production is in small-scale and, they maintain the agricultural production as usual without strong attention to make agriculture as an opportunity to get rich.

Table 5.17. Self-evaluation on equipment of household for production

	Frequency	Percent	Valid Percent	Cumulative Percent
under equipped	4	4.7	4.7	4.7
Acceptable equipped	49	57.6	57.6	62.4
well equipped	32	37.6	37.6	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

The self-evaluations of farmers have been analysed in table 5.16 to table 5.19. On the preparation work, 79/85 respondents stated that their tools have met their needs in which 35/85 households gave evaluation that their tools work perfectly for their requirement. In the production period, the corresponding figures were 81/85 and 32/85, whereas the figures for harvest work was 79/85 and 33/85 respectively. And in post-harvest work as preservation they were 79/85 and 39/85. However, examining the statistical value of these tools their low value which averages only 2.442 million VND (~ 90€), and the frequency of households with tools' value of 0.1 million VND (~ 3.5€) is 55/85 households. Examining the tools with a greater value, they are mostly milling machines, water pumps, simple facility for transportation, minor tillage machines. With such simple equipment for farmers who have satisfied the need for farm production in the region, it is shown that the simple type of production, small-scale production and using a model of labour intensive are popular more than using the capital intensive model in the region.

Table 5.18. Self-evaluation on equipment of household for harvesting

	Frequency	Percent	Valid Percent	Cumulative Percent
under equipped	6	7.1	7.1	7.1
acceptable equipped	46	54.1	54.1	61.2
well equipped	33	38.8	38.8	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

In fact, in recent years, the application of machines in many stages of agricultural production such as land preparation, planting, harvesting has freed up people from heavy jobs. The appearance of these machines in the rural areas is also increasing over time. Some farmers would invest in buying such machines and doing service with these machines while the others tend to hide these services. Due to small production scale, most

farmers tend not to invest too much in machines and facilities, and hire this service from others. Actually, it is an initial specialisation of farmers in the region.

Picture 5.4. Preparing job before rice growing on the field.

Table 5.19. Self-evaluation on equipment for post-harvesting

	Frequency	Percent	Valid Percent	Cumulative Percent
under equipped	6	7.1	7.1	7.1
acceptable equipped	40	47.1	47.1	54.1
well equipped	39	45.9	45.9	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

However, examining this situation in detail, i.e. examining the value and quality as well as the modern level of these machines, it is clear that those machines can only carry out basic tasks. Particularly, for harvest and post-harvest technology, there is a serious lack of necessary technologies and farmers themselves are not aware of it. Applying new technologies in these stages will allow farmers to diversify the structure of their products, to preserve and to maintain the value of agricultural products as well as to create additional

income. The application of such new technologies conform to the exploitation of the market for new products, and as a positive result, these factors will actively promote the production and application of innovations.

In summary, after examining these indigenous factors and their influences on the application of innovations for farmers in the region, these subjective factors have a certain influence in the application of innovations at farmers' household, including:

- Factor of educational level of farmers (examining the educational of the head of the household);
- Factor of geographical location of rural areas (next to large cities as surveyed locality in Haiphong, Hungyen or in distant from cities as surveyed locality in Thaibinh)
- Factor of ages of farmers (examining the ages of the head of the household)
- Factor of labour capacity of farmers' households (examining the population of household as well as full time/part time labour of households)
- Factor of structure of households' income
- Factor of farming's specification of household (examining cultivation farming, livestock farming, mixed cultivation and livestock farming)
- Factor of gender issues (examining the gender of the head of household).

Considering the reliability of statistics and statistical significance, there will be four main criteria taken into consideration and evaluation of quality and efficiency of the process of transfer agricultural innovations to farmers as:

- Factor of geographical location of rural areas
- Factor of educational level of farmers
- Factor of gender issues
- Factor of farming's specification

These four factors as four basic perspectives will be used to analyse the evaluation in the following parts.

5.3. The understanding of farmers about innovations and applying innovative advancements in their agricultural production

Starting with asking farmers about the time they start to apply innovative advancements in their agricultural production, I started a discussion with farmers to find out their perception of innovative advancements, their understanding about innovative advancements and their application towards innovative advancement are similar to technological issues as analysed in the previous part of theoretical issues of this thesis. The majority of statement who say the first year of application was 2000, were 31/85 respondents, or 36.5% of total surveyed farmers. In one case in Thaibinh, the farmer said that he applied innovations in his production since 1995. Others stated that these processes had been implemented since 2008 (9/85 respondents) (see Table 5.20).

Table 5.20. Year of applying innovative advancement

	Frequency	Percent	Valid Percent	Cumulative Percent
1995	1	1.2	1.2	1.2
1998	2	2.4	2.4	3.5
2000	31	36.5	36.5	40.0
2002	3	3.5	3.5	43.5
2003	8	9.4	9.4	52.9
2004	7	8.2	8.2	61.2
2005	8	9.4	9.4	70.6
2006	10	11.8	11.8	82.4
2007	6	7.1	7.1	89.4
2008	6	7.1	7.1	96.5
2009	3	3.5	3.5	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

Farmers also stated that the applicable S&T's achievements are advancements in seed, fertilisers, pesticides, intensive methods of farming, and new methods of growing, advanced machines and mechanical equipment. In addition, most of the farmers stated that the most innovative advancement which had been applied in their production was the advancement in seed and new procedures of farming (58/85 respondents, 68% - see Table 5.22). The other responses from farmers suggest that new breeding, new technical

methods, new fertilisers or pesticides were the most important. 13 out of the 85 respondents accounting for 15% of total reviews said that innovative advancements applied in their production are all of above mentioned innovations. These 13 respondents are all from households whose income and educational knowledge was high. Thus, it can be said that education is important to impact on innovations' awareness, allowing farmers to apply innovative advancement to increase their income.

Table 5.21. Cross-tabulation of "Applied innovations" and "Location"

	Location			Total
	Haiphong	Thaibinh	Hungyen	
New varieties	16	4	7	27
New breeds	1	4	5	10
New techniques in cropping	1	0	0	1
New techniques in fertilizer	2	0	1	3
all of above innovations	6	1	6	13
New varieties + New techniques in cropping	8	14	9	31
Total	34	23	28	85

Source: Data is collected from mye own survey in 2009.

Table 5.22. Cross-tabulation of "Applied innovations" and "Major agricultural activity of household"

	Major agricultural activity of household			Total
	Cultivation	Livestock	both cultivation and livestock	
New varieties	19		8	27
New breeds		10		10
New techniques in cropping			1	1
New techniques in fertilizer	2		1	3
all of above innovations	4	1	8	13
New varieties + New techniques in cropping	23		8	31
Total	48	11	26	85

Source: Data is collected from the own survey in 2009.

Box 5.4. Understanding farmers on the application of innovative advancement in agricultural production

As referring to "innovations" applied in farmers' agronomic production, most farmers just want to refer new technical issues as new seeds, new breeding, new fertilizer, new pesticide, new machinery, and not refer new non-technical factors such as new management measures, or methods of farming. This perception has limited the ability to mobilize and allocate resources for agronomic production at farm size.

Comment of an extension service staff in Thaibinh,

Source: Data is collected from the own survey in 2009.

Table 5.23 considers the relationship between the educational levels of farmers and understanding of innovative advancement. It shows that at low levels of education, seed was the most significant innovation recognised by respondents. Whilst at higher levels of education, their perception was wider including other types of innovation.

Table 5.23. Cross-tabulation of "Applied innovations" and "Educational level of the head of household"

	Educational level of the head of household				
	simple reading, writing and calculating	Graduated Primary school	Graduated Secondary school	Graduated High school	Total
New varieties		4	11	12	27
New breeds	2	5	2	1	10
New techniques in cropping			1		1
New techniques in fertilizer			2	1	3
all of above innovations	4	1	5	3	13
New varieties + New techniques in cropping	4	6	14	7	31
Total	10	16	35	24	85

Source: Data is collected from the own survey in 2009.

Taking the age of farmers as a control indicator it can be shown that farmers aged between 41 and 56 have a better recognition of the innovations (49/85 respondents). Unlike farmers

at other ages, who did not fully understand innovations or have no desire to learn about scientific and technical progresses in depth (farmers aged over 70). Farmers between the ages of 41-56 who have reached maturity in terms of psychological, health, productive experience, economic capability and the amount of time they had available carried out more research into innovations and their application in production. According to these farmers, innovations in agriculture not only include new seed but also include many other new elements.

Therefore, to promote the process of transfer and application of innovative advancement in agricultural production of farms' households, the awareness of farmers on the types of innovations should be seen as an important factor. Perception of farmers towards innovative advancement depends largely on education, age as well as the type agricultural sector. Besides, in case of already determine reasonable methods, suitable approaches to favourable applicants, the awareness by farmers on innovation would be raised up by diffusion effects, starting from farmers at the ages of 40-50 and having a high level of education.

5.4. Applying innovative advancement in agricultural production of farmers' household

The application of innovative advancement in agricultural production is a result of either passive or active transfer methods. This means the flow of innovative advancements could originate from farmers' demand or due to orders given by outside parties. In the survey, the majority of farmers stated that innovative advancements were diffused by state staff and implementation by farmers was mainly carried out under the guidance of these officials (37/85 accounted for 43.5%). The application of innovative advancement due to mutual exchange and learning between farmers was also hugely popular in the rural areas (29/85, 34.1%). These are the two most common opinions accounting for 77.6% of total farmers in the region. The remaining farmers, about 22.4% knew that applying innovative advancement would certainly bring profit 12/85 opinions (14.1%). These were normally the first to apply new techniques, and they consider applying innovative advancements as a means of increasing their competitiveness and dominate the consumption market. The remaining 7 farmers said that they have successfully implemented advancements and even they would use their own experiments as a sample for other farmers in the region so that they can adopt their success. There is not a significant difference in this figure across the

three provinces of Haiphong, Thaibinh and Hungyen. As such the application of innovative advancement is fairly similar for all localities in the region.

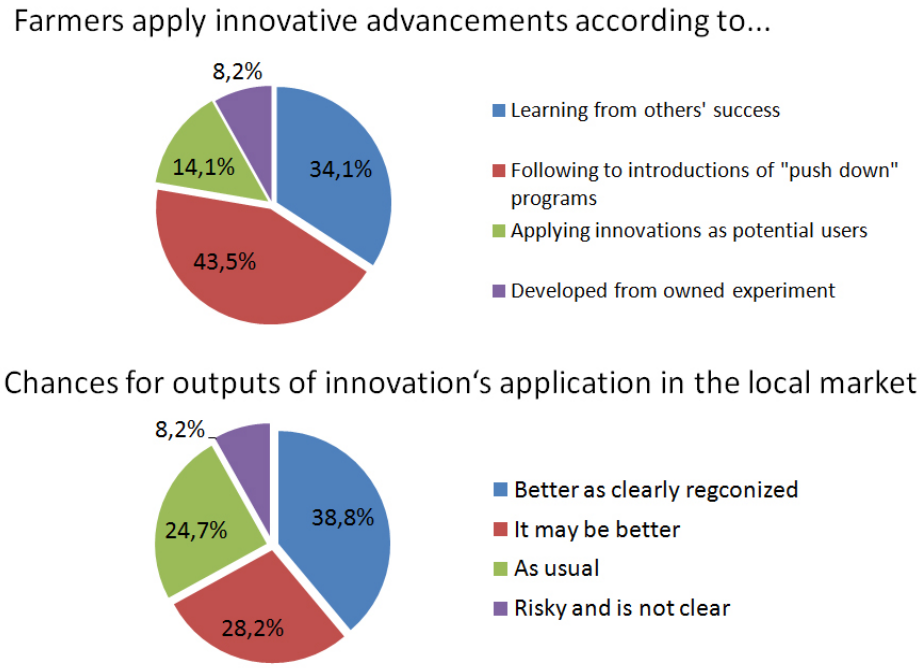


Figure 5.8: Applying S&T's achievement at farm

Source: Data is collected from the own survey in 2009.

Table 5.24. Cross-tabulation of "Reason for applying innovative advancements" and "location"

		Location			Total
		Haiphong	Thaibinh	Hungyen	
Learning from others' success	Count	11	6	12	29
	% of Total	12.9%	7.1%	14.1%	34.1%
Applying innovations as potential users	Count	4	4	4	12
	% of Total	4.7%	4.7%	4.7%	14.1%
Following to introductions of "push down" programs	Count	16	10	11	37
	% of Total	18.8%	11.8%	12.9%	43.5%
Developed from owned experiment	Count	3	3	1	7
	% of Total	3.5%	3.5%	1.2%	8.2%
Total	Count	34	23	28	85
	% of Total	40.0%	27.1%	32.9%	100.0%

Source: Data is collected from the own survey in 2009.

This is consistent with the theory that farmers acting as adopters would be classified into groups where potential adopters are always the pioneers in actively applying innovations. Determining the group of pioneer farmers successfully will facilitate extension workers to transfer innovations to farmers effectively to allow the widespread application of innovations in the region.

Table 5.25. Cross-tabulation of "reasons for applying innovative advancements" and "Gender of the head of household"

Reason for innovations' application		Gender of the head of household		Total
		Male	Female	
Learning from others' success	Count	14	15	29
	% of Total	16.5%	17.6%	34.1%
Applying innovations as potential users	Count	11	1	12
	% of Total	12.9%	1.2%	14.1%
Following to introductions of "push down" programs	Count	19	18	37
	% of Total	22.4%	21.2%	43.5%
Developed from owned experiment	Count	5	2	7
	% of Total	5.9%	2.4%	8.2%
Total	Count	49	36	85
	% of Total	57.6%	42.4%	100.0%

Source: Data is collected from the own survey in 2009.

When considering the effect of genders on enforcing the application of innovative advancements women are often seen as using passive approaches to adopt new things. They usually follow the success of others and use the process as recommended by extension workers rather than finding a suitable model for themselves. In comparison with 11 cases of men (Table 5.25), only one woman stated that she wished to apply innovative advancement as the first farmer in the community to do so. This analysis might better help officials to understand the behaviour of peasants when facilitating the transfer of innovative advancement to farmers. It may be better for officials to communicate with men rather than women when they need firstly potential adopters.

Picture 5.5. A discussion with group of farmers at their house.

Source. Own photo.

Table 5.26. Cross-tabulation of “Reason for innovations' application” and “Educational level of the head of household”

Reason for innovations' application		Educational level of the head of household				Total
		simple reading, writing and calculating	Graduated Primary school	Graduated Secondary school	Graduated High school	
Learning from others' success	Count	10	7	9	3	29
	% of Total	11.8%	8.2%	10.6%	3.5%	34.1%
Applying as potential users	Count		2	1	9	12
	% of Total		2.4%	1.2%	10.6%	14.1%
Following to "push down" programs	Count		7	21	9	37
	% of Total		8.2%	24.7%	10.6%	43.5%
Developed from owned experiment	Count			4	3	7
	% of Total			4.7%	3.5%	8.2%
Total	Count	10	16	35	24	85
	% of Total	11.8%	18.8%	41.2%	28.2%	100.0%

Source: Data is collected from the survey in 2009.

Table 5.27. Crosstabulation of "Chances for outputs of innovations application in market" and "Educational level of the head of household"

		Educational level of the head of household				Total
		simple reading, writing and calculating	Graduated Primary school	Graduated Secondary school	Graduated High school	
Better as clearly regconized	Count	6	6	9	12	33
	% of Total	7.1%	7.1%	10.6%	14.1%	38.8%
It may be better	Count		4	14	6	24
	% of Total		4.7%	16.5%	7.1%	28.2%
As usual	Count	4	6	6	5	21
	% of Total	4.7%	7.1%	7.1%	5.9%	24.7%
Risky and is not clear	Count			6	1	7
	% of Total			7.1%	1.2%	8.2%
Total	Count	10	16	35	24	85
	% of Total	11.8%	18.8%	41.2%	28.2%	100.0%

Source: Data is collected from the own survey in 2009.

Table 5.28. Crosstabulation of "Reason for innovations' application" and "Major agricultural activity of household"

Reason for innovations' application		Major agricultural activity of household			Total
		Cultivation	Livestock	both cultivation and livestock	
Learning from others' success	Count	15	5	9	29
	% of Total	17.6%	5.9%	10.6%	34.1%
Applying innovations as potential users	Count	3	3	6	12
	% of Total	3.5%	3.5%	7.1%	14.1%
Following to introductions of "push down" programs	Count	29	3	5	37
	% of Total	34.1%	3.5%	5.9%	43.5%
Developed from owned experiment	Count	1	0	6	7
	% of Total	1.2%	.0%	7.1%	8.2%
Total	Count	48	11	26	85
	% of Total	56.5%	12.9%	30.6%	100.0%

Source: Data is collected from the my survey in 2009.

Table 5.26, table 5.27 consider the influence of educational on farmers and their uptake of innovations. It shows that those who have a lower level of education are more likely to use

passive methods of adoption. In this situation, farmers always try to copy all guidance available rather than finding favourable methods to suit their farm. They may, even skip some of the suggested investments if they cannot afford them or do not fully understand them. Farmers with a higher level of education had a better understanding of the innovations they could apply and in some cases they created improvements to the techniques. To encourage the application of innovations in agricultural production further improving the educational level will help support the transfer process.

Examining the relationship between “level of education” and recognising “chance of outputs from the application of innovations in the market”, farmers whose educational level at high levels would recognise the chance for these products as well as their risk, while farmers at lower levels of education may not identify the risks of applying innovations. Therefore, this data reinforces the importance of education in improving the efficiency of applying innovations in agricultural production within the region.

Table 5.29. Chances for outputs of innovation's application in the market

	Frequency	Percent	Valid Percent	Cumulative Percent
Better as clearly regconized	33	38.8	38.8	38.8
It may be better	24	28.2	28.2	67.1
As usual	21	24.7	24.7	91.8
Risky and is not clear	7	8.2	8.2	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

Analysing the reasons for applying innovations by the agricultural sector shows that livestock farming is not highly innovative, and they mostly apply new things as recommended only. This situation is similar to cultivation farming whilst for mixed model of cultivation and livestock, farmers have generated a number of innovative techniques themselves. Six farmers stated that they had also created their own innovations and applied to agricultural production of their farm. Thus, the diversification of farming allows farmers to develop improvements. This situation suggests that extension workers diversify their topics in transferring innovations to farmers in combination with general knowledge of agricultural systems.

When examining the reasons for applying innovative advancement by types, the data shows that the improvements in seed normally comes from outside, while other innovative advancements such as the different methods of farming, changing the using of fertilizer,

combining crops and husbandry may originate from farmers own creativeness. These figures suggest that, in the promotion of applying innovative advancement to farmers' production, extension workers should clearly recognise what sort of improvements could be made by farmers, and when they introduce a new thing to farmers, they should emphasis what guidelines farmers should follow to when implementing innovative advancement.

Table 5.30. Cross-tabulation of "Innovations are applied" and "Reason for innovations' application"

Innovations are applied		Reason for innovations' application				Total
		Learning from others' success	Applying innovations as potential users	Following to introductions of "push down" programs	Developed from owned experiment	
New varieties	Count	2	5	19	1	27
	% of Total	2.4%	5.9%	22.4%	1.2%	31.8%
New breeds	Count	5	2	3		10
	% of Total	5.9%	2.4%	3.5%		11.8%
New techniques in cropping	Count				1	1
	% of Total				1.2%	1.2%
New techniques in fertilizer	Count			2	1	3
	% of Total			2.4%	1.2%	3.5%
New varieties + New techniques in cropping	Count	16	3	9	3	31
	% of Total	18.8%	3.5%	10.6%	3.5%	36.5%
all of above innovations	Count	6	2	4	1	13
	% of Total	7.1%	2.4%	4.7%	1.2%	15.3%
Total	Count	29	12	37	7	85
	% of Total	34.1%	14.1%	43.5%	8.2%	100.0%

Source: Data is collected from the own survey in 2009.

The data from the survey also shows that, in the early years of innovation implementation between 1995 and 1998, farmers innovated based on their own experiment. More recently the appearance of supporting organisations has helped provide innovative advancements and other technical recommendations for farmers. The efficiency of these organisations in operation, is measured by the success rate of increased production.

Table 5.31. Cross-tabulation of "Chances for outputs of innovations application in market" and "location"

Chances for outputs of innovations application in market		Location			Total
		Haiphong	Thaibinh	Hungyen	
Better as clearly regconized	Count	12	10	11	33
	% of Total	14.1%	11.8%	12.9%	38.8%
It may be better	Count	14	4	6	24
	% of Total	16.5%	4.7%	7.1%	28.2%
As usual	Count	6	7	8	21
	% of Total	7.1%	8.2%	9.4%	24.7%
Risky and is not clear	Count	2	2	3	7
	% of Total	2.4%	2.4%	3.5%	8.2%
Total	Count	34	23	28	85
	% of Total	40.0%	27.1%	32.9%	100.0%

Source: Data is collected from the own survey in 2009.

Cross-tabulation of "Chances for outputs of innovations application in market" and "Gender of the head of household"

Table 5.32. Chances for outputs of innovations application in market * Gender of the head of household Crosstabulation

Chances for outputs of innovations application in market		Gender of the head of household		Total
		Male	Female	
Better as clearly regconized	Count	21	12	33
	% of Total	24.7%	14.1%	38.8%
It may be better	Count	13	11	24
	% of Total	15.3%	12.9%	28.2%
As usual	Count	10	11	21
	% of Total	11.8%	12.9%	24.7%
Risky and is not clear	Count	5	2	7
	% of Total	5.9%	2.4%	8.2%
Total	Count	49	36	85
	% of Total	57.6%	42.4%	100.0%

Source: Data is collected from my own survey conducted in 2009.

Further to this 33 out of 85 respondents said that the application of innovative advancement definitively provides better results. Whereas 24 out of the 85 stated that the results seemed to be better, with 21 farmers saying that there had been no change in

production when applied innovative advancements were applied. Seven respondents in particular stated that the application of innovative advancements is risky and also significantly reduced the production of households (see Figure 5.8 and table 5.29).

Taking gender into account, there was no significant difference between male and female in the evaluation (Table 5.32). It is similarly as regarding the factor of locations (Table 5.31). Therefore, we can conclude that the application of innovative advancements is relatively uniform within the Red River Delta.

An examination of the risks which occur (and lead to unexpected results) during the process of applying innovative advancements to agricultural production was carried out. A number of issues has emerged such as natural disasters, risks associated with the output market, instability of input markets and poor-quality fertilisers. When these risks are not controlled, they impact on the productivity of household farms. In addition, the limitations in recognising the usefulness of innovations has also affected negatively to the process. Overcoming these problems would allow farmers to improve the efficiency in applying innovative advancements in their production.

5.5. Finance for the application of innovative advancements in households' production

Examining the financial resources of household to invest in applying innovative advancements in their agricultural production, Table 5.33 shows that 5 basic financial sources were highlighted including self-funding, loans from relatives and friends with zero interest rates, short-term loans from individuals with high interest rates, loans from credit institutions and banks, investment from businesses or enterprises (funded under assigned agreement in contracts) and the lastly - commercial credit (called late payments for providers). Depending on the nature and scale of the application and seasonal criterion of innovative advancements, farmers' mobilise finance from all sources above. In fact, most farmers use their own saving to invest in innovation. This is strongly reflected in the survey as 80 out of 85 cases are self funded. This is because the funds required for technical innovations such as seeds, fertilizers, pesticide is often not big. Only when farmers required a big amount of money in a short period of time, i.e. for buying seed in bulk, expanding scale of production, and other expensive items then farmers look for finance from other sources. A majority of farmers (35/85) turned to relatives and friends for loans as these came with zero interest rates. The third most popular was loans from

credit institutions and banks (32/85) or short-term loans from individuals with high interest rates (23/85). The least popular option was taking up investment from businesses or enterprises within the framework of assigned contract (14/85). The mobilisation of finance as commercial credit although highly popular in the rural areas, only used for small investments for short term loans only.

Table 5.33. Capability in getting finance for innovation application

		Self financed	Credit from family without interest	Private credit from private with high interest	Credit from the banks	Investment from partners
N	Valid	80	35	23	32	14
	Missing	5	50	62	53	71
Mean		2.00	2.74	3.57	3.72	4.36
Median		2.00	2.00	3.00	4.00	4.00
Minimum		1	1	2	1	4
Maximum		5	5	5	5	5
1 = very easy; 2 = easy; 3 = normal; 4 = difficult; 5 = very difficult						

Source: Data is collected from the own survey in 2009.

Two different criteria have been used to analyse the sources of financial support, these include the ease of availability and the potentiality in satisfying need. (See Tables 5.34 to 5.38). The examination has revealed that the funds from three sources of self-funding (57/80 opinions in table 5.34), or loans from relatives and friends with zero interest rates (22/35 opinions in table 5.35), or short-term loans from individuals with high interest rates (14/23 opinions in table 5.36), are easy to obtain only satisfy farmers requirements for a small amount of investment. Whereas the funds from credit institutions and banks (7/32 opinions in table 5.37), or from businesses or enterprises within the framework of a contract (0/14 opinions in table 5.38) appear to be more difficult to get hold of. Despite this they can provide a big amount of money in adaptation with the growing time and development of crops and animals. For example farmers may borrow up to 50 million VND per household from credit institutions or banks, even when farmers meet the conditions and standards of a standard regulated farm, the maximum loan they would be able to have would be 500 million VND per farm. This loan is a relatively large investment in implementing innovative advancements therefore with a small demand of capital for investment, farmers prefers the three previous types of capital sources. However, when making a greater investment, they prefer to deal with two types of financial sources later.

An understanding of the finance options available and the ability for these to be used flexibly by farmers would further facilitate the application of innovations on farms within the RRD region.

Table 5.34. Self financed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very easy	32	37.6	40.0	40.0
	Easy	25	29.4	31.3	71.3
	not so easy but acceptable	16	18.8	20.0	91.3
	Difficult	5	5.9	6.3	97.5
	very difficult	2	2.4	2.5	100.0
	Total	80	94.1	100.0	
Missing		5	5.9		
Total		85	100.0		

Source: Data is collected from the own survey in 2009.

Table 5.35. Credit from family without interest

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very easy	2	2.4	5.7	5.7
	Easy	20	23.5	57.1	62.9
	not so easy but acceptable	4	4.7	11.4	74.3
	Difficult	3	3.5	8.6	82.9
	very difficult	6	7.1	17.1	100.0
	Total	35	41.2	100.0	
Missing		50	58.8		
Total		85	100.0		

Source: Data is collected from the own survey in 2009.

The ability of farmers being able to get loans for applying innovative advancements in the three provinces has been examined. The results show that there have been difficulties in self-funding in Thaibinh and Hungyen, whilst there appears to be no funding problems in Haiphong.

Table 5.36. Private credit from private with high interest

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Easy	2	2.4	8.7	8.7
	not so easy but acceptable	12	14.1	52.2	60.9
	Difficult	3	3.5	13.0	73.9
	very difficult	6	7.1	26.1	100.0
	Total	23	27.1	100.0	
Missing		62	72.9		
Total		85	100.0		

Source: Data is collected from the own survey in 2009.

Table 5.37. Credit from the banks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very easy	1	1.2	3.1	3.1
	Easy	6	7.1	18.8	21.9
	Difficult	19	22.4	59.4	81.3
	very difficult	6	7.1	18.8	100.0
	Total	32	37.6	100.0	
Missing		53	62.4		
Total		85	100.0		

Source: Data is collected from the own survey in 2009.

Table 5.38. Investment from partners

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Difficult	9	10.6	64.3	64.3
	very difficult	5	5.9	35.7	100.0
	Total	14	16.5	100.0	
Missing		71	83.5		
Total		85	100.0		

Source: Data is collected from the own survey in 2009.

This is especially clear when considering the other sources of finance from family and friends and through short-term personal loans with high interest rates. In fact, the economic capability of farmers in Haiphong is stronger, and there is a greater source of non-official capital funds (loans from individuals based mostly on trusts among partners in a same community). This is due to the greater opportunities available for earning an income from non-agricultural work, as well as the ability to get flexible loans current from individuals is

much easier in Haiphong compared with the other two provinces. On the other hand, the structure of the economy is also different in Haiphong, where the proportion of agriculture in GDP is smaller than that of industry and services. That situation allows people to shift a part of their savings from other sectors to agricultural production. Thus, to continue encouraging capital investment in agricultural advancements, diversifying the economic sectors and changing the structure of the economy would be very useful.

Table 5.39. Crosstabulation of "Self financed" and "location"

		location			Total
		Haiphong	Thaibinh	Hungyen	
very easy	Count	13	9	10	32
	% of Total	16.3%	11.3%	12.5%	40.0%
Easy	Count	10	5	10	25
	% of Total	12.5%	6.3%	12.5%	31.3%
not so easy but acceptable	Count	7	5	4	16
	% of Total	8.8%	6.3%	5.0%	20.0%
Difficult	Count	2	2	1	5
	% of Total	2.5%	2.5%	1.3%	6.3%
very difficult	Count		1	1	2
	% of Total		1.3%	1.3%	2.5%
Total	Count	32	22	26	80
	% of Total	40.0%	27.5%	32.5%	100.0%

Source: Data is collected from the own survey in 2009.

Table 5.40. Cross-tabulation of “Credit from family without interest” and “location”

		location			Total
		Haiphong	Thaibinh	Hungyen	
very easy	Count	1		1	2
	% of Total	2.9%		2.9%	5.7%
Easy	Count	13		7	20
	% of Total	37.1%		20.0%	57.1%
not so easy but acceptable	Count	3		1	4
	% of Total	8.6%		2.9%	11.4%
Difficult	Count	1	1	1	3
	% of Total	2.9%	2.9%	2.9%	8.6%
very difficult	Count	1	1	4	6
	% of Total	2.9%	2.9%	11.4%	17.1%
Total	Count	19	2	14	35
	% of Total	54.3%	5.7%	40.0%	100.0%

Source: Data is collected from the own survey in 2009.

Data in table 5.40 reveals that credit from family without interest in Haiphong and Hungyen seem to be easier than in Thaibinh. The number of farmers who obtain credit from this source is greater in Haiphong (19) and Hungyen (14) in compare with Thaibinh (2).

The number of farmers using banks is 5 cases in Thaibinh in compare with 14 cases in Haiphong and 13 cases in Hungyen. However, the opinions made by farmers suggest that it is more difficult to obtain this financial loan.

Table 5.41. Cross-tabulation of "Private credit with high-interest" and "location"

		location			
		Haiphong	Thaibinh	Hungyen	Total
Easy	Count		1	1	2
	% of Total		4.3%	4.3%	8.7%
not so easy but acceptable	Count	9		3	12
	% of Total	39.1%		13.0%	52.2%
Difficult	Count	2		1	3
	% of Total	8.7%		4.3%	13.0%
very difficult	Count	1	1	4	6
	% of Total	4.3%	4.3%	17.4%	26.1%
Total	Count	12	2	9	23
	% of Total	52.2%	8.7%	39.1%	100.0%

Source: Data is collected from the own survey in 2009.

Table 5.42. Cross-tabulation of "Credit from the banks" and "location"

		location			
		Haiphong	Thaibinh	Hungyen	Total
very easy	Count			1	1
	% of Total			3.1%	3.1%
Easy	Count	2	2	2	6
	% of Total	6.3%	6.3%	6.3%	18.8%
Difficult	Count	10	1	8	19
	% of Total	31.3%	3.1%	25.0%	59.4%
very difficult	Count	2	2	2	6
	% of Total	6.3%	6.3%	6.3%	18.8%
Total	Count	14	5	13	32
	% of Total	43.8%	15.6%	40.6%	100.0%

Source: Data is collected from the own survey in 2009.

All respondents across the three provinces stated that gaining financial support from partners was "difficult". These figures show that the requirement for finance is different in three provinces. Although farmers in three provinces all preferred the self-finance, farmers in Thaibinh were less involved in the uptake of other financial sources in comparison with farmers in Haiphong and Hungyen. The survey also shows, farmers in Haiphong and Hungyen may find easier in getting hold of other sources of finance than farmers in Thaibinh. This fact has revealed a real demand from farmers in the region for capital investment for production, especially for applying innovative advancement in production.

Table 5.43. Cross-tabulation of “Investment from partners” and “location”

		location			Total
		Haiphong	Thaibinh	Hungyen	
Difficult	Count	7		2	9
	% of Total	50.0%		14.3%	64.3%
very difficult	Count	2	1	2	5
	% of Total	14.3%	7.1%	14.3%	35.7%
Total	Count	9	1	4	14
	% of Total	64.3%	7.1%	28.6%	100.0%

Source: Data is collected from the own survey in 2009.

Table 5.44. Cross-tabulation of “Self financed” and “Gender of the head of household”

		Gender of the head of household		Total
		Male	Female	
very easy	Count	21	11	32
	% of Total	26.3%	13.8%	40.0%
Easy	Count	16	9	25
	% of Total	20.0%	11.3%	31.3%
not so easy but acceptable	Count	5	11	16
	% of Total	6.3%	13.8%	20.0%
Difficult	Count	5		5
	% of Total	6.3%		6.3%
very difficult	Count	2		2
	% of Total	2.5%		2.5%
Total	Count	49	31	80
	% of Total	61.3%	38.8%	100.0%

Source: Data is collected from the my survey in 2009.

Considering the impact of gender factors and the capability of farmers to obtain capital sources (see Table 5.44 to table 5.48), for the sources of self-funding and unofficial capital, women seem to be able to access and utilise funds more easily, whereas it is often more difficult for men. This fact fits to the general characteristics of women as they tend to save and use money more for their families. In addition, investors are more likely to have confidence in women in comparison with men in rural society. However, there appears to be no difference in the numbers of men and women taking up official funds and those from banks and other credit institutions. Thus, when determining the objects of lending, with the goal of preserving capital, the sex of farmers, as well as the financial status of the farmer, should be included as a criterion.

Table 5.45. Cross-tabulation of "Credit from family without interest" and "Gender of the head of household"

		Gender of the head of household		Total
		Male	Female	
very easy	Count		2	2
	% of Total		5.7%	5.7%
Easy	Count	8	12	20
	% of Total	22.9%	34.3%	57.1%
not so easy but acceptable	Count	1	3	4
	% of Total	2.9%	8.6%	11.4%
Difficult	Count	3		3
	% of Total	8.6%		8.6%
very difficult	Count	6		6
	% of Total	17.1%		17.1%
Total	Count	18	17	35
	% of Total	51.4%	48.6%	100.0%

Source: Data is collected from the my survey in 2009.

The survey has also shown that the ability of farmers from different educational backgrounds to access investment options or loans is the same for all levels. This fact proves that most farmers with any level of education are aware of the different types of capital, conditions for loans and the lending regulations. In other words, the procedures and regulations for loans of any types of capital are fairly well understood by all borrowers.

The obvious difficulty here is only conditions attached to these loans, and other regulations such as how long the loan is for and the interest rate.

Table 5.46. Cross-tabulation of "Private credit with high interest" and "Gender of the head of household"

		Gender of the head of household		Total
		Male	Female	
Easy	Count		2	2
	% of Total		8.7%	8.7%
not so easy but acceptable	Count	4	8	12
	% of Total	17.4%	34.8%	52.2%
Difficult	Count	3		3
	% of Total	13.0%		13.0%
very difficult	Count	6		6
	% of Total	26.1%		26.1%
Total	Count	13	10	23
	% of Total	56.5%	43.5%	100.0%

Source: Data is collected from the own survey in 2009.

Table 5.47. Cross-tabulation of "Credit from the banks" and "Gender of the head of household"

		Gender of the head of household		Total
		Male	Female	
very easy	Count	1		1
	% of Total	3.1%		3.1%
Easy	Count	3	3	6
	% of Total	9.4%	9.4%	18.8%
Difficult	Count	9	10	19
	% of Total	28.1%	31.3%	59.4%
very difficult	Count	3	3	6
	% of Total	9.4%	9.4%	18.8%
Total	Count	16	16	32
	% of Total	50.0%	50.0%	100.0%

Source: Data is collected from the my survey in 2009.

Table 5.48. Cross-tabulation of "Investment from partners" and "Gender of the head of household"

		Gender of the head of household		Total
		Male	Female	
Difficult	Count	3	6	9
	% of Total	21.4%	42.9%	64.3%
very difficult	Count	2	3	5
	% of Total	14.3%	21.4%	35.7%
Total	Count	5	9	14
	% of Total	35.7%	64.3%	100.0%

Source: Data is collected from the own survey in 2009.

In this survey, some farmers suggested that the length of a loan might need to be extended as this would be more appropriate with the amount of time for growth - development – and the maturity of plants and animals. Furthermore, it would also be more suitable for loans to end at certain times of the year. The implementation of regulations for loans would also allow farmers to borrow capital and, therefore, invest more in innovations. In addition, some farmers also proposed that the conditions relating to loans (loan amount, loan conditions and interest rate) should be altered to allow them to access official loans with low interest rates rather than the non-official sources with high interest. According to the experience of some foreign banks, the fact that everyone has a personal account insured by certain mortgages or trusts to withdraw money from an account as more than available (over withdrawing) has allowed the account holders to keep up their payments. Currently, the option to open an account with an overdraft is only available in certain banks and is also only reserved for special customers such as enterprises or businessman. Vietnamese farmers generally do not know this service, even they do not have normal bank accounts. Furthermore, banks are also encouraging people to use services such as credit cards, VISA, MASTER and many others. However, these offers come with very high interest rates; and farmers are still not being informed about these services. In reality, farmers are still not familiar with such services. Vietnamese farmers still have many difficulties accessing financial sources even traditional financial institutions. Due to the RRD's relatively well developed infrastructure and rural society, the expansion of modern banking services to farmers is feasible. The use of these modern services will allow farmers more flexibility and enable them to connect with capital markets more easily. This will also help solve

many current difficulties with capital requirements. The responsibility of solving problems with financial capital should fall to the farmers themselves or agricultural administrations with the implementation of socio-economic projects. Alternatively, it should be the responsibility of agricultural enterprises with contracts to provide input materials. Finally, the participation and support of banks and credit institutions is important in providing a solution.

5.6. The difficulties of applying innovative advancement

The analysis of farmer's views on the difficulties of applying innovative advancements in their production shows (see Table 5.49) that mastering the innovative advancements were very easy for 19 respondents (23%), 30 respondents (37%) stated that advancements were easy to be applied. Furthermore, 21 respondents (26%) said that they were difficult to implement but farmers were still be able to understand the processes. However, 12 respondents (15%) said that they were difficult to be applied. The data on this topic also does not differ between results from men and women. In addition, there was also no difference among the views of farmers in all three provinces as well as between the education levels. Finally, there was also no significant difference for cultivation farms, livestock farms and mixed farms. This fact reveals that, the diffusion of innovations to farmers has been undertaken widely and consistently. In other words, it suggests that farmers in the RRD region have an equal opportunity in accessing new knowledge and innovative advancements. The core issues might be the acceptance of them as the role of customers and the efficiency of extension services.

For the difficult levels of applying innovative advancements, they are just temporarily divided into two opposite types: easy to apply and difficult to apply. Most farmers agreed that innovative advancements are easy to apply (53 respondents), but as in further investigation, two cases occur. The first case occurred as because they were qualified to perceive new knowledge as well as monitor and memorize the entire process of demonstration. And the second cases occurred as they considered that introduced innovations were very easy, without any specialities, as well as the technique involved, was not so difficult to adopt, to understand and to apply. Therefore, one successful experience is emerged from practice as the process of transfer innovative advancements should be done systematically, with uniform knowledge, easily to understand, easily to observe comprehensively, simple to memorize all technical guidance, simplify the implementation, and familiar with the knowledge of local farmers. These concerns would

enhance the efficiency of the transfer process providing information to farmers about the new technique a uniform, complete a comprehensive system, as well as appropriate information and simple implementation, consistent with and the ability to apply new thing of local farmers. In fact, besides training, extension workers also distributed leaflets and brochures containing information on specific innovation that helped farmers remind about new things. This form has been approved by many responses and proves its effectiveness.

Table 5.49. Cross-tabulation of "Difficulties in getting new techniques and mastering these techniques" and "gender of the head of household"

		Gender of the head of household		Total
		Male	Female	
very easy	Count	10	9	19
	% of Total	12.2%	11.0%	23.2%
Easy	Count	15	15	30
	% of Total	18.3%	18.3%	36.6%
not so easy but acceptable	Count	15	6	21
	% of Total	18.3%	7.3%	25.6%
Difficult	Count	7	5	12
	% of Total	8.5%	6.1%	14.6%
Total	Count	47	35	82
	% of Total	57.3%	42.7%	100.0%

Source: Data is collected from the own survey in 2009.

For the farmers (15%) who stated that it was difficult to apply these techniques, a further investigation showed that there are two different types of respondents. Firstly farmers did not regularly follow the training and visiting demonstrated by extension services' agents. This leads to a lack of guidance when trying to implement new technologies and techniques. Most farmers in this situation are people did not change their farming methods to follow the demonstrations made by extension workers or they do not pay enough attention when in contact with extension workers. Secondly farmers were not able to apply new techniques as they were too difficult to be adopted in their fields. In addition, they did not know how to handle problems which arose during the implementation process. There are also two types of farmers in this group with the first type were slow to recognise the concepts they were shown by extension workers. The others were really willing to apply

difficult innovative advancements such as expanding their production to large scale farming with the help of a set of innovations. This statement is appropriate to the fact when transferees do not contact with farmers often. Information about innovative advancements is still inconsistent and not enough to meet the demand for self-understanding and synthesis of farmers. In many cases, due to difficultly in accessing sources of information and technical advice, farmers do not know who can help them. In addition, sometimes farmers have access to consultation, but by this point it is too late in the season. Therefore, the enhancement of communication between farmers and consultation is needed. The first step they should take is to create easier guidance to enable farmers to participate fully. Furthermore, inquiries or forums should be used. The collection of all related documentation in a specific library or building, as well as using sample models for trainings and visits, should also be utilised. The use of these should also depend on organisational capacity and conditions of the region itself. Each community should own a main channel of information appropriately. Historically, in the RRD agricultural co-operatives have been quite effective in collecting and guiding farmers to implement unique application plans. However, in a modern agriculture there is increasing demand from farmers as well as requests from the application of innovative advancements have exceeded the response capacity of the old model of agricultural co-operatives. Therefore, the conversion of agricultural co-operatives into agricultural service co-operatives also aims to satisfy the demands of members. However, in fact, this model still has many weaknesses. In addition to the operation of agricultural service co-operatives, the organisation of farmers' associations such as the Women's Association, Farmers' Unions, Youth Unions, interest clubs and others have contributed to the diversification farmers this support for transferring innovations to specific groups of farmers. These local associations have contributed positively to the propagation of innovations. However, the operations of these associations have overlapped, even their operations are unprofessional and include a lot of information from social purposes. Thus, an establishment of professional channels for innovative information would help farmers in collecting, synthesising and exploiting innovations in the rural areas.

5.7. Forms of approaching to farmers

In the previous sections, the data used is mainly derived from feedback from farmers on the application of innovation. The way of conducting such analysis would clarify the nature of farmers’ behaviour in applying innovation by farmers’ own assessments. In this

section, when analysing the approach to farmers, the opinions of farmer and transferees are also included. The transfer process is considered from two angles: the opinions of the transferee and those of the receivers.

The analysis used this assumption: There are many ways of approaching to transfer innovations to farmers, however, the most effective way should start from the demand of farmers.

Farmers generally recognised that there are three common ways of implementing innovations which are carried out by transferees as either individuals or organisations. The three ways include (1) Simply providing information and productive methods (information is only transferred in one direction) following their own plan, (2) Working together with farmers identify problems and find practical solutions but to their active involvement, (3) Working together with farmers to identify problems and to find practical solutions, but due to farmers' active role.

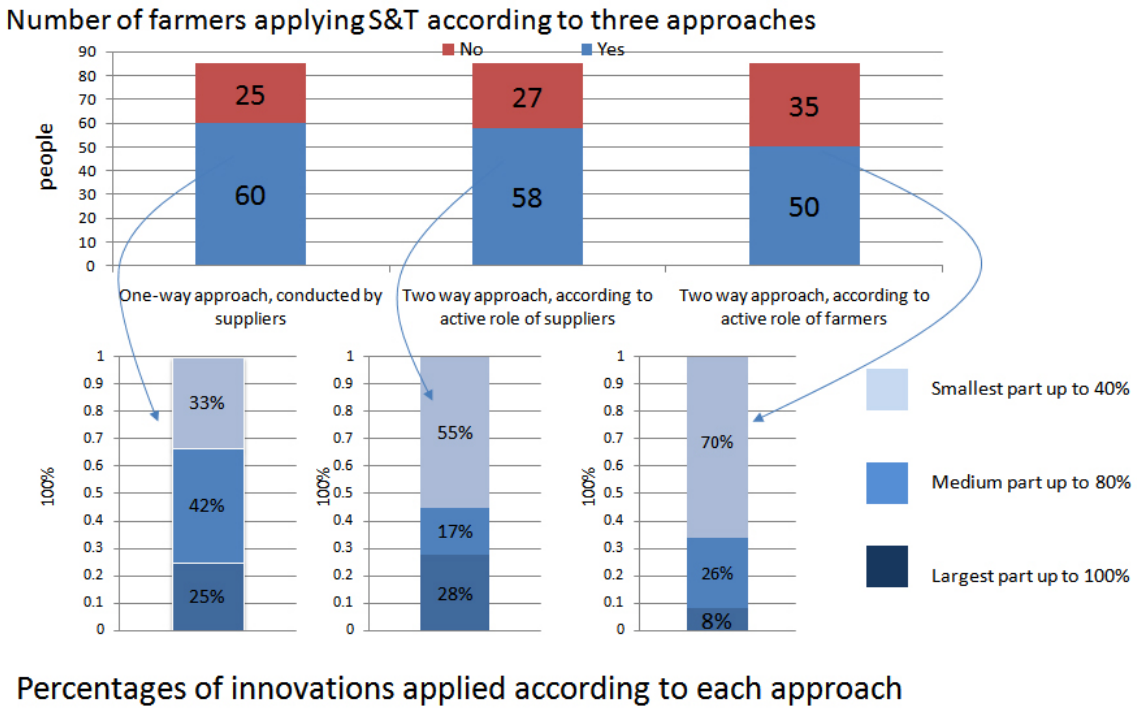


Figure 5.9: Approaching to farmers according to farmers' assessment

Source: Data is collected from the own survey in 2009.

The innovations are not transferred through only one approach independently to a household, but they also might be transferred through three approaches together. The data showed that following to approach I, 60 farmers said "yes", while 25 said "no". Similarly,

following to approach II, 58 said “yes” and 27 said “no”, while following to approach III, 50 said “yes” and 35 sai “no”. In a first comparison, the approach I and II have dominated the trend.

With the effort in measuring the transfer process following to approach III, I have examined the 50 farmers with “yes” answer. In most of farmers (70%), the proportion of transferred innovative advancements by this approach only occupy a small amount (around 1-40%) of their total applied innovative advancement. Only 8% farmers (in 50 said “yes”) said that most of their applied innovative advancements are transferred by this approach. These figures revealed that even innovations are transferred to farmers through approach III, however, only a small amount of applied innovations in a farmer household are transferred by this way. The remains are transferred by other two approaches. That means most of innovative advancements are transferred to farmers is following to passive transfer.

Table 5.50. Collection of farmers’ evaluation on their percentages of innovations would be applied following to different approaches

	80-100%	40-80%	1-40%	0%
App 1	15	25	20	25
App 2	16	10	32	27
App 3	4	13	33	35

Source: Data is collected from the own survey in 2009.

In details, there were 15 respondents (18%) stated that about 80 - 100% of innovations are transferred using the first approach of “simply providing information and productive methods one-way following their own plan”, in whereas 25 respondents (29%) said that around 40 - 80% of innovations were transferred using this method. Twenty respondents (24%) had the view that 1 - 40% of innovations are transferred by this way whilst 25 respondents (29%) stated that none of the innovations were transferred using this method. This data means 60 respondents (71%) concerning positive answers at different percentage levels as shown above.

Regarding the second approach of working “together with farmers to identify problems and to find practical solutions due to their active involvement”, in total 58 respondents provided positive feedback on this method (68%) at different percentage levels. As such, there were 16 respondents (19%) who stated that 80 - 100% of innovations are transferred

by this way. Furthermore, 10 respondents (12%) said that 40 - 80% of innovations used this method of transference, 32 respondents (38%) stated that this occurred for between 1 – 40% of innovations, and finally 27 respondents (32%) stated that none of the innovations were transferred in this manner. For the third approaching of "together with farmers to identify problems and to find practical solutions, but due to farmers' active role only 50 respondents (59%) provided positive feedback Four respondents (5%) stated that 80 – 100% of innovations were transferred in this way. Further to this 13 respondents (15%) said that approximately 40 – 80% of innovations used this method, whereas 33 respondents (39%) believed that 1 – 40% of innovations used this way of transference. Finally, 35 respondents (41%) stated that none of the innovations were transferred by this way.

Analysing the data from the survey, results suggest that the first approach is commonly used and the most popular within the region. Despite there being three approaches used in the process of innovation transference to farmers in the RRD, the active participation of farmers is not generally considered. This can be shown by the percentage of positive responds for approach 1, 2 and approach 3 are 71%, 68% and 59% respectively. These figures also allow the same conclusion to be made for all the percentage levels (80-100%, 40-80%, 1-40% and 0%). However, the active participation of farmers directly in the transfer process and their active role in the transfer has been mentioned, as indicated in the data table. Changes in the approach towards farmers have also been observed where the role of farmers is becoming more active and positive. Communication with farmers and organisations/individuals acting as transferees occurs for a variety of reasons, for example in order to actively introduce new techniques to farmers such as the marketing of new seeds/seedlings (mainly done by technical/marketing staff from seed companies), or to solve farmers problems relating to the practical application of innovations (mainly done by regional extension staffs at the district level). Furthermore this communication allows technical support to be arranged as well as investment in applying new techniques. This investment is agreed through in the contracts between farmers and agricultural enterprises (mainly conducted by agricultural enterprise staff as assigned to contract with farmers for material production). In fact in practice the scale of farm production usually affects farmer's decisions as well as actively seek information about innovations. For example, in large-scale production the application of innovations significantly impacts the productivity and quality of agricultural products as well as improving the efficiency of the farms investment. Therefore farmers will actively seek new techniques as well as look for

technical consulting. Conversely for farms with small-scale production farmers' motivation to actively seek information and technical advice is not as strong. In this situation, transferees need to be very active in communicating with farmers to encourage them to adopt innovations. However, the active promotion on the part of the transferees is necessary because maintaining the relationship with farmers will also be a prerequisite for co-operation in the future. With this in mind the government should adopt policies to encourage the increased production on large and small scale farms. Currently the methods used to increase the scale of agricultural production in the RRD focuses on encouraging land's accumulation for agricultural production, exploiting unused land, or consolidating small plots into bigger ones as well as issuing long term stable land-use policies. Despite this there still need initiatives to enhance the process in order to improve the efficiency of exploiting agricultural land in the area.

Recently, a new kind of co-operation between agricultural enterprises, farmers and extension agents has been developed. In this co-operation, farmers and other partners make an agreement and sign a contract whereby agricultural land is leased out to enterprises at a reasonable price and for a certain time period. As such, farmers become enterprises' workers and the extension agents are then responsible for technical transferring. However, this model is currently in the trial stages and has only been applied at certain locations. This model also requires difficult negotiation and has a number of constraints.

Another model that is also being used focuses on the co-operation between agricultural enterprises and extension services' agents. This method has been used in Haiphong and agricultural enterprises co-operate with extension workers to combine their ideas and plans on how to transfer innovative advancements to farmers. Enterprises are therefore responsible for achieving certain output standards whilst extension workers are responsible for negotiating with farmers to produce these products and to apply standard techniques. The success of this model depends very much on those who participate actively in the co-operation. The focus of local experts is mostly cantered on the point where agricultural enterprises start to actively try and establishing these co-operations. This is because the transfer of innovative advancements to farmers would allow enterprises to create a profit would serve directly for the profit of enterprises, regarding to quality, quantity as well as efficiency of enterprises' inputs. On the other hand, extension workers would receive financial support from the enterprise to complete an assigned job and as such creating better dynamic for their operation.

As a result of these practical experiments, the Vietnamese government has recommended the implementation of a program to allocate state funds encouraging co-operation between enterprises and local extension agents. In addition, local extension agents need to identify their customers not only farmers but also the new agricultural enterprises. In addition, agricultural enterprises are not only the potential customers of extension agents but also a possible provider of funding for extension services. Maintaining the relationship and co-operation between extension services and agricultural enterprises would help to further promote agricultural development in the region towards a highly modern production focusing on commodity productionA state program with state budget allocation might be implemented under authorization management of a fund, focusing investment mainly for the extension agencies and R&D indirectly, but through the operation of eligible agricultural enterprises with necessary requirement (for example, the record of enterprises should be in appropriate field, satisfying requirement of historical experience since establishment, and so on).

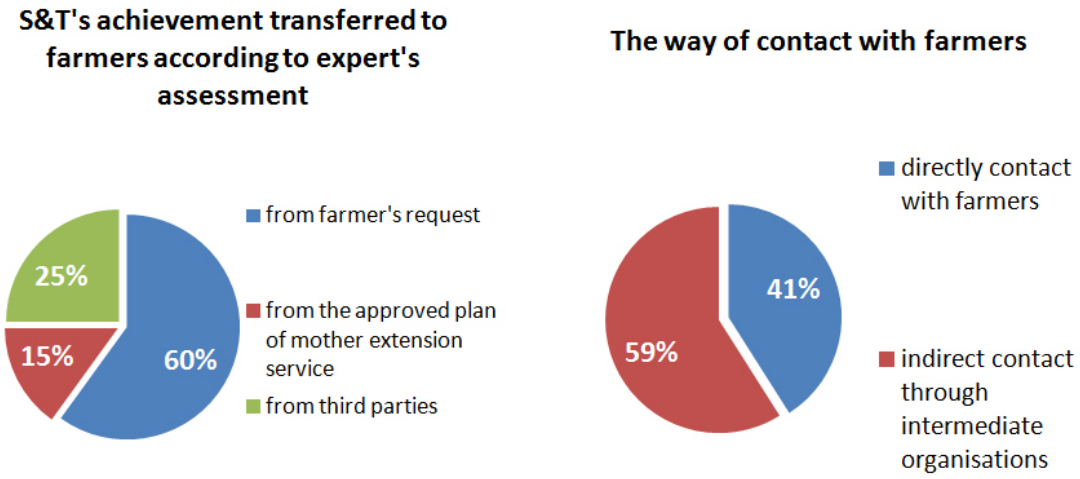


Figure 5.10: Approaching to farmers according to experts' view

Source: Data is collected from the own survey in 2009.

Examining the evaluation of experts, the data from the survey also shows that out of the total innovative advancements transferred to farmers around 60% original from requests, 15% as a result of approved plans originating from the extension services. Whilst 25% are a result of orders from third parties. Third parties include agricultural firms, local authorities and NGOs. The information above reveals that most requests are made by the State.

With reference to the ways in which farmers are approached transferees directly contact farmers or through an intermediate organisations in the region. In fact, most of the meetings are done indirectly through local organisations such as farmers' unions, women's union and interest clubs. Even for extension services, where their expertise is needed to transfer innovative advancements (see Table 5.52) the percentage of those working directly with farmers has only reached 41%. The remaining 59% of meetings are conducted through intermediaries within the local area. Although the network of extension services has been extended to reach the communal level through the operation of collaborators, the support from the local association in organising meetings with local farmers is needed. This fact shows the importance of the different organisations and associations roles in the process.

During the meetings with farmers, transferees usually use common methods such as local workshops (using prepared reports/presentations) as well as discussions with active farmers and investing T&V models (as samples) and delivering brochures and flyers.

5.8. The factors influencing the process of transfer innovative advancements to farmers which are recognised by transferee

Previously, I have mentioned that endogenous factors including characteristics of farmers and their capabilities directly influence their willingness to apply innovative advancements. In addition, other exogenous factors have also impacted on the process of transferring and applying innovative advancements in agricultural production. This section examines these influences by reviewing the opinions of farmers and experts on which exogenous factors are and their influence at different levels from "no impact" to "very strong". Through several discussions with agricultural experts and farmers, the study has revealed 9 exogenous factors affecting farmers and 6 exogenous factors mainly impacting transferees. This influences the efficiency of the transfer as well as application of S&T's achievements to farmers in the RRD (see Table 5.51 to Table 5.53). In Table 5.51, the factor of "changing of international demand" shows the minimum influence on agricultural production while the factor of "output's market" has a very strong influence. Other factors such as "The availability and quality of inputs market", "Impact of natural disaster, bad weather" have also had a strong impact. Furthermore, other factors such as the "Support of technical staff" the "Support of intermediate organisations" the "Support of government in accelerating the application of innovations" and the "Infrastructure conditions such as

transportation, irrigation and electricity" have had a lesser impact on the process. These factors will be analysed in detail in the following sections 5.8.1. to 5.8.9.

Table 5.51. Evaluation of 15 experts on influences of exogenous factors

	Not impact	Weak	Normal	Strong	Very strong
Output's market					15
Support of technical staff			2	13	
Support of intermediate organizations			7	8	
Capability of farmers and their willingness			8	7	
Infrastructure condition as transportation, irrigation, electricity		2	2	9	2
The available and quality of inputs				11	4
Support of government in accelerating the application of innovations			4	11	
Impact of natural disaster, bad weather			2	8	5
Changing of international demand	9	2	2	2	

Source: Data is collected from the own survey in 2009.

In addition, other factors such as the facilitation of the operation of transferees have also impacted on the quality of transferred activities. For these factors, "accommodation for agents", and "Investment for tools/equipment" have had a greater impact. However, the factors of "the conformity of content of transferring to farmers", "methodologies of transference" seem to have been undervalued. This is due to transferees considering that these factors have been satisfied. Further to this, this result show that transferees do not think much about improved methods of transfer or finding appropriate topics for farmers. This may actually be a weakness on the part of the transferees as they have not recognised the importance of these issues.

With above evaluation, quality of extension service seems to be satisfied. Actually, this satisfaction is only reasonable for small scale production and the simple implementation of innovations. Almost all innovative advancements transferred by extension agents are simply technical innovations. This is the reason why transferees are not generally concerned about the content of transference or methods used. A number of difficulties have

emerged when applying innovation on large farms, which are focused towards commodity production, or when implementing difficult techniques which require a certain level of understanding. Difficulties have also arisen when trying to apply specific techniques, which need the infrastructure to be at a certain level of development. These difficulties include issues such as finding markets for agricultural outputs, a lack of funding for extension workers to be able to contact farmers and purchasing small amounts of land. Furthermore, poor transportation and a lack of a reliable electricity supply also constrain the implementation of innovations.

Table 5.52. Evaluation of 15 experts on the facilitation of transferring innovations to farmers

	Not impact	Light impact	Normal	Strong impact	Very strong impact
Accommodation for agents		6	7		2
Investment for tools/equipment		5	6	2	2
The conformity of content of transferring to farmers	10	3		2	
Methodology of transferring	8	3		4	
The support of infrastructure	2	5	2		6
Interest clubs of farmers		3	2	6	4

Source: Data is collected from the own survey in 2009.

The data in table 5.53 shows the opinions of transferees, which mostly concentrate on the willingness of farmers to apply innovations. The willingness is an endogenous factor that is one of the most important ones as the transfer of innovative advancements can only be successful when farmers want to do it. The other factors can be arranged in three groups. The first group includes factors with clearly positive influence on the process of innovation, in order of importance these are: “Healthy status of recipients” “Economic wealth of recipients”, “Educational level of recipients”, “Educational level of recipients”. The second group includes factors with normal influence on the process, in order of importance these are: “Being a member of a local association”, “Areas of land possession”. The third group includes factors with unclear influence to the process, in order of importance these are: “Being a member of a local association”, “Age of recipients”, and “Genders of recipients”.

Table 5.53. Evaluation of transferee on the factors influencing to the behavior of farmers in applying innovations

	Not regarding	Litle regarding	Normal	Strong impact	Very strong impact
Educational level of recipients		2	2	5	6
Age of recipients	2		4	7	2
Genders of recipients	4		9	2	
Healthy status of recipients			3	10	2
Economic wealth of recipients		2	2	11	
Areas of land possession		2	11	2	
Being a member of a local association	2		3	8	2
Strong willingness of applying innovation				8	7
Strong power in local society		4	3	8	

Source: Data is collected from the own survey in 2009.

According to this arrangement, transferees may have a better understanding about favourable approach as well as using suitable strategies to transfer innovative advancements to farmers in the region.

5.8.1. Market for agricultural inputs

In total 85 farmers were asked to give their opinions on the role of market for agricultural inputs, in which many innovations such as seed, fertiliser, pesticides and machines are sold. In total, there were 78 respondents (92%) provided feedback and 16 respondents (21% of total responses) complained about the bad quality of these inputs (Table 5.54). These respondents considered that market of inputs plays a quite important role in their production. Many complaints about this market focused on the poor quality of purchased items, or hazardous items, which were not controlled by the authorities.

These opinions have indicated the weakness of local management. In fact, when a dispute arises due to the poor quality of inputs, farmers will have to bear all losses without any compensation. This reflects the fact that in general, consumers in Vietnam have not been protected. On the other hand, because the damage is not great due to the small scale of production, these disputes are normally ignored. Even though, the value of losses is not very high, it shows weaknesses in the local authorities' management as well as

fragmentation in production. Moreover, is shows negligence. Improvement in terms of efficiency and quality of market inputs will provide significant support for the development of production, and moreover, contribute to build a more modern production.

Table 5.54. Evaluation of farmers about market of inputs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very bad	2	2.4	2.6	2.6
	Bad	14	16.5	17.9	20.5
	Normal	15	17.6	19.2	39.7
	Good	45	52.9	57.7	97.4
	very good	2	2.4	2.6	100.0
	Total	78	91.8	100.0	

Source: Data is collected from the own survey in 2009.

5.8.2. Extension services

Table 5.55. Evaluation of farmers on the role of extension services' agents in their production

	Frequency	Percent	Valid Percent	Cumulative Percent
Very bad	1	1.2	1.3	1.3
Bad	3	3.5	3.9	5.2
Normal	24	28.2	31.2	36.4
Good	40	47.1	51.9	88.3
Very good	9	10.6	11.7	100.0
Total	77	90.6	100.0	

Source: Data is collected from the own survey in 2009.

Opinions about extension services were collected from two different groups from farmers (as recipients or beneficiaries) and from extension experts (as providers of this service). With reference to the feedback from farmers, most of them (77 responses in 85 asked) confirmed the importance of extension services in supporting their output. In the table 5.55, 44 responses have stated that extension services have very strong influences on production. However, only four responses gave negative feedback on the role of extension services. Farmers also suggested that the quality of services provided by extension workers needed to be improved as well as the frequency of communication. Some the other

opinions focused on the ways knowledge is transferred. These suggestions are not new to extension agents, but still helpful for them to improve their quality of operation.

The local extension services play the role of transferring innovations, mostly technical advancements in cultivation and livestock, to local farmer. The transferred objects come with clear technical criteria. However, faced with questions from farmers on the best solutions for increasing their outputs, or how to sell their products, as well as possible systems of production or potential solutions relating to peripheral areas such as management and marketing, extension workers normally have difficulties in answering them. In reality, the improvements in management and marketing methods are not frequently involved in the transfer of innovation. Recently, advanced machines have been transferred to farmers. However, farmers are mainly looking for markets for their products or looking for management skills without any guidance from outside organisations. This fact might not be a great problem for farms which have small-scale production, however, is a big constraint for those with large-scale production. Dealing with such issues would be very helpful for farmers to approach towards commodity production.

Picture 5.6. A typical working place of an extension agent at district's extension service station.

In addition to extension services, other organisations are also involved in this process, for example, local authorities (through socio-economic programs) or agricultural firms as well as agencies for plant protection, or veterinary agencies, or even farmer themselves. For instance, the DARD, and the district division of agriculture participate in formulating T&V sample models for certain technical demonstrations. Furthermore, plant protection agencies transfer innovative advancements relating to new pesticides. In addition, veterinary agencies do the same work in their tasks. Recently, the agencies of plant protection have been responsible for building demonstrative models for a modern agricultural production following the introduction of clean standards such as VIETGAP. This program has had a great deal of impact on farmer's traditional methods of production, and as such could create great dynamics for farmers to change their production towards modern commodity production. It could also satisfy the current increasingly high demand for high-quality products in the market.

Picture 5.7. A local official shop where farmer can buy innovative inputs for their agricultural production.

Evaluation of extension agents on the changes of agricultural production that are resulted from applying innovative advancements has shown a significant influence. The changes

are observable in changes of quality and quantity of output products as well as changing in running production. Production currently has been simplified with greater support from new machines as well as less attention being paid to the care of plants. Moreover, a new cycle of advancement is shortened by the time, for example, a renew cycle of rice cultivar is often happened in only three years. Therefore, the work of introducing innovative advancements to farmers should be implemented frequently. The opinions of extension experts shown in table 5.56 indicate the effect of applying innovative advancements to farms.

Table 5.56. Changes in production by the application of innovative advancements

	Not impact	Weak	Normal	Strong	Very strong
Changing the way of agricultural production				13	2
Positive contribute to the economic growth			4	9	2
Positive effect on the natural environment		2	4	9	
Negative effect on the natural environment			9	6	
Changing the way of consumption (people care about purchasing safe products than other products)		2	9	4	
Changing the social-interest of innovative thinking			9	6	
People consider the role of local authorities and other association in supporting the innovative process			7	8	
More investment from state budget for agricultural R&D			7	6	2

Source: Data is collected from the own survey in 2009.

To satisfy demands from farmers, extension workers must also improve their professional knowledge as well as other skills. There are many forms of learning, updating and improving the professional qualifications available to them, but their uptake mainly depends on the initiative of extension staff. In terms of an official organisation, annually, extension agencies at the provincial level have organised a competition to help encourage

staff to become more qualified. In addition, they provide several short training courses aim to provide their staff new skills and knowledge. Furthermore, extension officers also look for other long-term training courses, for example, at universities to upgrade their qualifications. The level of active participation of extension officers is shown in the table 5.57. This data shows that, their participation in training courses is forcible task, while looking for cooperation with agricultural firms is self-initiative activity individually.

Table 5.57. The ways of improving qualification of extension workers

	Obligatory mission	Individual demand	By both
Collecting information in mass media as television, radio, internet, newspaper		6	9
Participating in the short training courses	15		
Participating in the educational courses	7	8	
Getting contact with business organization for new contracts		15	
Getting the feedback of farmers and looking for solution from outside	5	2	8
Upgrading skills of staff by standardization	3	12	
Attending workshop	4	11	

Source: Data is collected from the own survey in 2009.

The activity of extension workers in collecting new solutions and knowledge also relies on the administrative level of organisation they work for, and on the nature of innovations. Normally, for the extension organisations with a higher level of administration, i.e. at the provincial level, their workers will have more assigned tasks whilst at the lower administrative levels; extension workers should be more active in organising work themselves. The proportion of state funding in total income of one extension worker decreases as the administration level of organisations increases. At the lower level, i.e. at district level, extension workers will have most their income from state budget, while at higher level, i.e. at provincial level, the proportion of state budget in their income is smaller. That means at higher level of administrative organisation, extension workers will have more chances to look for income from other sources outside state budget. In addition, the provincial extension agencies provide greater support for their staff to improve their knowledge and skills.

Table 5.58. Sources of innovations that can be transferred to farmers

	Not regarding	Little regarding	Normal	Strong impact	Very strong impact
Deliver from mother agencies		2	6	5	2
Own research		7	8		
Transferring from other domestic institute	2		9	4	
Transferring from overseas	4	9	6		
Ordering from enterprises	4	3	6	2	
From Tivi, Radio, Newspaper, internet	2	2	4	7	

Source: Data is collected from the own survey in 2009.

Box 5.5. The allocation of innovations under different views

In Haiphong province, opinions of experts in provincial agencies said that 30% of total transfer is coming from orders of mother agencies and functional missions, and 70% of tasks are coming from others. Meanwhile, at the district level, in Kienthuy district, opinions of experts said that 70% of tasks are coming from orders of mother agencies and just only 30% of the task is coming from practical production.

(Source: Data is collected from the own survey in 2009.)

Extension experts in their feedback from the survey said that most innovations were delivered from mother agencies. These mother agencies were the major source of innovations. The other providers of innovations were listed as R&D organisations, or local extension agencies, importation from abroad, as well as enterprises and mass media channels such as television, radio and the internet. Meanwhile, innovations from domestic R&D organisations are mainly important for extension services. Extension agencies at the provincial level have confirmed the important role of this source, while extension agencies at the district level just confirmed two important sources of innovations. One source are the provincial extension agencies with 65% of total transferred innovation, and the other is the collection from practice with 35% of total transferred innovation. In reality, many improvements have been collected from practical production of farmers. Typically, such innovations have emerged in the livestock sector with new formulas of combining animals in the production. Furthermore, developments have been made in creating appropriate

models for agricultural production in combination with energy saving, and so on. The experts stated that about 20-25% of agricultural innovations are generated from practical production and the remain 75-80% of innovations are generated by professional organisations.

Examining the working time allocation for extension workers has revealed that the time taken to contact farmers accounted for 55% of their available time. Whereas 20% of time is reserved for the task of transferring innovations, the remaining 25% is used for other activities. Therefore, time for the task of transfer innovation might be mobilized more in the reservation of that 25%. However, it is necessary to issue appropriate mechanism for encouraging extension workers, i.e. financial support.

Table 5.59. The allocation of time of extension workers (%)

	N	Minimum	Maximum	Mean	Std. Deviation
Time for updating/upgrading obligatory career	15	10	30	20.00	6.268
Time for approaching farmers	15	20	70	54.67	16.847
Time for other mission/private activities	15	10	70	25.33	20.569
Valid N (list wise)	15				

Source: Data is collected from the own survey in 2009.

When assessing the structure of income of extension workers, it is cleared that income from their main tasks makes up 86% of their total income. Furthermore, the income from co-operation with enterprises makes up 12% and the proportion of income from co-operation with mother agencies or foreign organisations (from projects funded from overseas) is only 2%. Most of the income for extension workers is provided by the state budget, especially for those staff working at lower levels of administration. At these levels, the income from enterprises or from projects funded from overseas is rare.

With reference to the communication between extension services and farmers, extension experts said that they had a close contact with farmers. Meetings with farmers to transfer innovative advancements should be carried frequently because the cycle of renewing innovations is becoming shorter nowadays. Through these, farmers will have the chance to communicate directly with extension experts and consult them when they have any

problems. In many cases, farmers contact expert too late. However, this type of contact only happens between farmers and extension experts up to district level and normally, farmers contact with collaborators of extension service at the communal level only. Therefore, it is necessary to provide more frequent training for experts at communal level and district level and improve their capability to source information on innovations as well as provide more support for their operation either through financial support or facilitation.

Table 5.60. Sources of extension workers' income (%)

	N	Minimum	Maximum	Mean	Std. Deviation
From the job of transferring innovations to farmers	15	80	95	85.67	6.510
From business enterprises	15	5	20	11.67	5.563
From overseas, mother agencies	15	0	10	2.67	4.577
Valid N (list wise)	15				

Source: Data is collected from the own survey in 2009.

At the lower levels within the organisational structure of extension services, the task of transfer innovations to farmers are limited to simpler jobs such as disseminating innovation according to assigned tasks and guidance coming from mother agencies. They are also not really informed about research activities, looking for other sources of innovations as in co-operating with firms. In most practical discussions with farmers, they focus much on technical guidance and avoid the non-technical issues such as management advancement. It can be explained by the nature of their work does not require highly specialised knowledge, moreover, staff at the grassroots level do not specialise in research, and only focus on the activities following to the assigned duties. At the lower levels, extension workers also faced obviously with financial difficulties. This fact is explained by considering the structure of income of extension agents at different levels as analysed in the previous part.

The survey shows that generally extension agents were satisfied with the facilitation methods used to implement innovations such as tools for media introduction, or tools supporting transference. The extension agents at the provincial level impose a high impression to the infrastructure while the extension agents at lower levels do not concern this issue. This fact might be explained by the scale of production being smaller, and

further investment in the infrastructure is not required. However, for large-scale developments, investment in infrastructure should be considered.

In addition to the effort of extension agents themselves to improve the quality of their operations, the government should also invest in extension services as they have an important role in enhancing a modern production in the rural areas. State investment is not only focused on organisational structures or programs encouraging the direct transfer of knowledge and application of innovative advancements, but expands to encouraging extension agencies to look for other co-operations, for example, with agricultural firms to invest in innovations and transfer advancements.

5.8.3. Market for outputs of agricultural production

Table 5.61 shows that most farmers (75/85 respondents) appreciate the importance of markets for agricultural products. In the survey, 35 respondents (47%) stated that currently this process was operating at a good or very good level. That means most agricultural products of farmers are sold at good prices without any difficulties. Despite this 15 respondents (20%) considered this to be operating at a bad or very bad level. Therefore, there are still many difficulties relating to find markets for outputs of agriculture.

Table 5.61. Output market following to farmer's evaluation

	Frequency	Percent	Valid Percent	Cumulative Percent
very bad	1	1.2	1.3	1.3
Bad	14	16.5	18.7	20.0
Normal	25	29.4	33.3	53.3
Good	32	37.6	42.7	96.0
very good	3	3.5	4.0	100.0
Total	75	88.2	100.0	

Source: Data is collected from the own survey in 2009.

An important finding of the survey was farmers concern for finding appropriate markets for their goods. For example, farmers asked questions as if I invest more in applying innovations on my farm, I would have an increased harvest, and then where can I sell these products? In some interviews, they showed a strong willingness to have support from government in finding markets for their products. They said, if the market for outputs is clear and sustainable, they may really invest in innovations in agricultural production. On

the one hand, this suggests that farmers experience difficulties in finding output markets, and, on the other hand, farmers are still highly dependent on the supporting of government. Solving the problems associated with the output markets in reality is not only a mission for government or farmers, but for all economic entities of the economy.

The views of farmers on this topic are similar to those made by extension experts (see Table 5.51) where all experts were concerned with the significant impact on the process of transferring innovations to farmers. Markets for agricultural outputs can be considered as the key issue in encouraging all farmers to apply innovation.

5.8.4. Operation of local associations of farmers in the region

With reference to theory, the role of local associations can be seen as positive contributors to the process of transfer innovative advancements to farmers. Reviewing the opinions of farmers (see Table 5.62) 30 respondents (41%) suggest "farmer associations play normal role in connecting farmers and transferees", while 11 respondents (15%) suggest that their role of these associations is not important. The large remain 32 respondents (44%) state that farmers associations perform a positive role in connecting farmers and transferees.

Table 5.62. Local clubs of interests and associations

	Frequency	Percent	Valid Percent	Cumulative Percent
very bad	2	2.4	2.7	2.7
Bad	9	10.6	12.3	15.1
Normal	30	35.3	41.1	56.2
Good	29	34.1	39.7	95.9
very good	3	3.5	4.1	100.0
Total	73	85.9	100.0	

Source: Data is collected from the own survey in 2009.

According to opinions of extension experts shown in table 5.51, they believe that these types of associations have a strong impact of on the process of transfer innovative advancement to farmers. This viewpoint is most likely due to the fact that extension workers contact farmers mostly through these kinds of organisations.

In reality, the operation of associations really supports the dissemination of innovation. Through these forums, farmers may contact each other to get more information and consult others on plans they will make for the future. They also allow farmers to view the result of

other experiments, which hope to solve problems which have emerged during the implementation stages.

5.8.5. Infrastructure factors

Infrastructure factors play an important role in supporting the process of innovative transfer. These factors include minor fields such as local transportation, electricity, irrigation systems, news and information systems.

Picture 5.8. A modern inner-field transportation

Source. Own photo.

With reference to the local transportation including inter-village roads, inter-communal roads, inner-fields' roads, the majority of roads have been concreted in recent years. This development has facilitated the easier transportation of things in and out of their fields. Out the 85 farmers surveyed, 85 respondents answered (Table 5.63). This suggests that farmers were very interested in the factor of local transportation. In the survey, 40 respondents (47%) said that the development of local transportation was operating at a normal level, 18 respondents (21%) stated that it was operating at a good level, whilst 27 respondents (32%) said that their local transportation was in a bad condition and causing difficulties when

they wanted to expand their production. This data also reveals that some farmers might expand their production scale if all other supporting factors are favourable. Therefore, more investment in local transportation is still needed to satisfy the need of modern production towards commodity production, as well as supporting for the development of rural areas.

Table 5.63. Level of development of the local transport system

	Frequency	Percent	Valid Percent	Cumulative Percent
very bad	6	7.1	7.1	7.1
Bad	21	24.7	24.7	31.8
Normal	40	47.1	47.1	78.8
Good	15	17.6	17.6	96.5
very good	3	3.5	3.5	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

The survey of farmers suggests that the condition of the local electricity network, better than local transportation (see Table 5.64). Out of the 85 respondents (100% of total asked farmers), 28 respondents (33%) believed the condition was at a normal level whilst 42 respondents (49%) considered that local electricity was well developed, and the remaining 15 respondents (18%) considered the system to be in a bad condition. In fact, although rural electricity has been invested in recent years, electricity is mainly used for the daily demand of farmers in the rural areas.

Table 5.64. Evaluation of farmers in the development of the local electricity system

	Frequency	Percent	Valid Percent	Cumulative Percent
very bad	7	8.2	8.2	8.2
Bad	8	9.4	9.4	17.6
Normal	28	32.9	32.9	50.6
Good	39	45.9	45.9	96.5
very good	3	3.5	3.5	100.0
Total	85	100.0	100.0	

Source: Data is collected from the own survey in 2009.

Table 5.65. Evaluation of farmers on the local irrigation system

	Frequency	Percent	Valid Percent	Cumulative Percent
Bad	21	24.7	25.0	25.0
Normal	30	35.3	35.7	60.7
Good	29	34.1	34.5	95.2
very good	4	4.7	4.8	100.0
Total	84	98.8	100.0	

Source: Data is collected from the own survey in 2009.

The application of electricity in production is not so developed, just mostly used for initial processing services and irrigation. Furthermore, due to difficulties in producing electricity, plus the increasing energy demands from other industries, the electricity allocated for agriculture and rural areas is being squeezed. In this context, in order to exploit and apply the advantages of using electricity in agricultural production, the development of tools and equipment, machinery and the importation of new machines from abroad needs to be carried out. In addition, the efficient use of this energy will support the development of modern agriculture.

Regarding inner-field irrigation systems including inner-field canals, shown in table 5.65, 30 respondents (36%) considered that the irrigation system was at a normal level of development, 33 respondents (39%) evaluated the system being well-developed, and the remaining 21 respondents (25%) considered that the system was in bad condition. These evaluations originate from the satisfaction of farmers about the quality of irrigation service and the expectations of farmers on the quality of services. In fact, in recent years, a program to concrete all inner-field canals has enhanced the efficiency of irrigation for agricultural production in the region. In addition, hydropower development in the Red River watershed has influenced the distribution of water downstream. As a result of climate change, there has been a real decrease in surface water, which has caused water shortages for agricultural production. Therefore, more investment in inner-field irrigation systems is needed to distribute water effectively for the development of agricultural production in the region.

Picture 5.9. Newly concreted irrigation system.

Regarding news and information system, the data in table 5.66 shows that, 24 respondents (29%) considered that the development of this system operates at normal a level, 54 respondents (65%) suggested that this was at a more developed level, while only eight respondents (10%) stated that this was underdeveloped. The data shows that the development of news and information systems within in the region is quite good. Information and news are distributed by many different channels, especially information about innovation. However, how to exploit this advantage to support for development of agricultural production in the region is a major issue.

Table 5.66. Evaluation of farmers views on local news and information system

	Frequency	Percent	Valid Percent	Cumulative Percent
Bad	8	9.4	9.6	9.6
Normal	24	28.2	28.9	38.6
Good	44	51.8	53.0	91.6
very good	7	8.2	8.4	100.0
Total	83	97.6	100.0	

Source: Data is collected from the own survey in 2009.

Regarding machines supporting for agricultural production, not like evaluation on individual facilitation in the previous part, the developed level of machines in this evaluation is provided by farmers as in a whole view. They expect to apply more advancement in mechanics to support production. With such expectations, 18 respondents (23%) said that the development of machinery is operating at a normal level, 32 respondents (40%) stated that it was well development and 29 respondents (37%) said the machinery is underdeveloped. In the long-run investment in machinery and equipment for agricultural production is required. Investment in this field also concerns the application of mechanical innovations and would support for the application of other innovations. For example, applying machinery in preparation jobs will facilitate the exploitation of seasonal factors, increasing intensive production.

Table 5.67. Machinery and Tools for preparation, harvesting and conservation

	Frequency	Percent	Valid Percent	Cumulative Percent
very bad	4	4.7	5.1	5.1
Bad	25	29.4	31.6	36.7
Normal	18	21.2	22.8	59.5
Good	28	32.9	35.4	94.9
very good	4	4.7	5.1	100.0
Total	79	92.9	100.0	

Source: Data is collected from the own survey in 2009.

In conclusion, infrastructure plays an important role in supporting agricultural production in the region. At certain levels, more investment needs to be made in infrastructure to satisfy the needs of applying innovations. In addition to practical observations, the development of infrastructure is proportional to the level of implemented innovation in agricultural production. The same can also be observed when asking the opinions of extension agents (see Table 5.51). In table 5.51, some of the experts considered local infrastructure is well developed while other experts said infrastructure was in bad condition and needs to be upgraded. These evaluations depend on the expectations of each expert as well as their satisfaction at different levels of production. Normally the current infrastructure would satisfy the requirement of small scale production, however, for larger scales investment would need to be made.

5.9. Sources of information for innovations

In the previous parts, I have analysed the development of the system of news and information within the RRD region; however, this has only provided a general view. In the analysis, most of the farmers considered that the system of news and information in the locality was well developed, and farmers were satisfied with the support of this system. Therefore, in this section, I assume that the information about innovations is available, but farmers may not approach these sources. The reasons would be: (1) farmers may not consider the importance of innovations, as well as (2) farmers may have limitations in approaching innovations".

Considering the sources of information about innovations in the RRD reveals that information about innovation may come to farmers from (1) specific programs of extension services on the mass media such as news papers, televisions programs and the radio (2) guideline as the functional tasks of extension services, (3) guideline from local authorities, (4) guideline from agricultural enterprises when they invest for their partners in assigned contracts , (5) guideline of R&D organisations as creators of innovations, and (6) friends and relatives through mutual exchange and learning, (7) local associations or unions of farmers.

5.9.1. Information about innovations from television

Table 5.68. Deriving Information from television

	Haiphong	Thaibinh	Hungyen	Total
very inefficient	1	4	2	7
Inefficient	10	4	11	25
Normal	5	1	3	9
Efficient	9	7	7	23
very efficient	6	4	3	13
Total	31	20	26	77

Source: Data is collected from the own survey in 2009.

Examining the evaluation of 85 farmers on the source of information from television (see Table 5.70), 77 farmers have responded (91%); however, eight farmers (9%) did not answer, because they were not interested in such extension programs, though the percentage of households who possessed television in the RRD is 99% . Out of the 77 respondents, 32 respondents considered that these programs were not effective, nine

respondents stated that they were of normal influence, and 36 respondents considered these programs were effective. That means these programs have a positive effect on farmers, and they may learn from such programs or even they can apply the suggested innovations successfully in their own production. Taking other factors such as educational level, location of resident, gender issue into account there is no clear trend in these evaluations. Thus, information about innovations on television has reached all individuals in the region.

5.9.2. Information about innovations from newspapers

Table 5.69. Information getting from newspapers by location

	Location			Total
	Haiphong	Thaibinh	Hungyen	
very inefficient	11	3	8	22
Inefficient	2	0	2	4
Normal	3	1	2	6
Efficient	2	3	2	7
very efficient	0	1	0	1
Total	18	8	14	40

Source: Data is collected from the own survey in 2009.

Regarding to this source of innovations, there were only 40 respondents (47%). That means a large proportion of farmers do not consider newspapers to be a source of information about innovations. Out of the 40 respondents, six respondents considered that newspaper may provide information about innovations at a normal level, only eight respondents have a positive evaluation with consideration as newspaper may provide useful information about innovations, and especially 26 respondents considered that newspaper do not provide any useful information about innovations. This rate of respondents is much lower in comparison with the source of information from television. Table 5.71 focuses on the factor of locations. Haiphong has the highest number of farmers who were interested in reading the newspaper (18/40), after this is Hungyen (14/49), and finally, the last is Thaibinh (8/40). Thus, although there is not an evident trend it seems to show that farmers at localities near to cities (Haiphong) may be more familiar with television and newspaper than other localities (Thaibinh).

Similarly, taking all the educational grades of farmers into account, farmers who have a higher education are more familiar in reading newspapers than farmers with lesser

education. Regarding the influence of gender into these evaluations, in comparison to men, women tend to have a lower rate when they explore the information about innovations efficiently (2/18 respondents from women in compared with 6/22 respondents from men). Despite this, difference between the numbers of men and women who read the newspaper is not high (22/40 male and 18/40 female). When considering the influence of the above factors in order to transfer information about innovation to farmers in the region, it is neccessary to choose an appropriate facilities and forms of approaching to farmers at certain groups, or at different grades of education and gender. For example, enhancing the use of newspapers in areas where is close to cities, while utilising the television as the main method to transfer innovations to farmers in remote areas. Furthermore, encouraging the use of newspapers among male farmers or farmers those with high levels of education rather than other groups seem to be more appropriate. In parallel to this, enhancing the operation of mass media tools in disseminating information about innovations also help farmers to understand more the reality behind a success application of innovations. This stories would encourage farmers in their search for suitable innovations to apply in their production.

Table 5.70. Information getting from newspapers in relate to gender of the head of household

	Gender of the head of household		Total
	Male	Female	
very inefficient	9	13	22
Inefficient	2	2	4
Normal	5	1	6
Efficient	6	1	7
very efficient	0	1	1
Total	22	18	40

Source: Data is collected from the own survey in 2009.

5.9.3. Information about innovations from the internet

With reference to the internet as a source of information, the rate of respondents was only 34% (29/85), the remaining 57 cases are not interested in using the internet. They also did not know the internet may provide useful information relating to innovations in agriculture.

However, for a growing economy the rate of 34% of farmers interested in using the internet is relatively high.

In fact, farmers do not know how to search for necessary information on the internet and the rate of farmers who do not find the needed information is very high (27/29 = 93%). Therefore, in order to enhance the use of the internet, farmers should be given some training and some basic knowledge as to how they can use the computer and the internet to look for information. The survey shows that Haiphong had the highest number of farmers who utilise the internet (14/29), followed by Hungyen with the rate of 10/29, and finally Thaibinh had a lowest rate of only 5/29. Despite Thaibinh being the locality where the farmers' rate of using the internet is lowest, farmers there may have a better understanding and skills in finding useful information on the internet as the respondents of 2/5 said that useful information was found.

Table 5.71. Information getting from the internet by locations

		Location			Total
		Haiphong	Thaibinh	Hungyen	
very inefficient	Count	14	3	10	27
	% of Total	48.3%	10.3%	34.5%	93.1%
Efficient	Count		1		1
	% of Total		3.4%		3.4%
very efficient	Count		1		1
	% of Total		3.4%		3.4%
Total	Count	14	5	10	29
	% of Total	48.3%	17.2%	34.5%	100.0%

Source: Data is collected from the own survey in 2009.

Similarly, men had a higher rate of using the internet (20/29) in comparison with women (9/29). This trend was also observed at the different levels of educational background.

5.9.4. Source of information about innovations from extension agencies

The surveyed data has indicated the high rate of 94% (80/85) of consideration of farmers on the importance of extension agents in providing innovations about innovation from extension agents. This data shows the important role of extension agents in providing information about innovations to farmers in comparison to other sources.

The rate of usefulness of information on innovations provided by extension agents was quite high (78% or 62/80). The feedback from farmers on the effectiveness of this source also does not differ between farmers in different areas or at different levels of education or gender. In fact, the system of extension services in RRD has expanded to district level with the service being represented by collaborators at the communal level. In their functional operation, extension services transfer innovations to farmers by several ways and approaches, such as short training courses, workshops, creating T&V models, or other modern participated models. Farmers also considered that these sources of information are one of the best.

Table 5.72. Information getting from extension agents by locations

		Location			Total
		Haiphong	Thaibinh	Hungyen	
very inefficient	Count	1	1	2	4
	% of Total	1.3%	1.3%	2.5%	5.0%
Inefficient	Count	2			2
	% of Total	2.5%			2.5%
Normal	Count	7	1	4	12
	% of Total	8.8%	1.3%	5.0%	15.0%
Efficient	Count	16	10	15	41
	% of Total	20.0%	12.5%	18.8%	51.3%
very efficient	Count	6	9	6	21
	% of Total	7.5%	11.3%	7.5%	26.3%
Total	Count	32	21	27	80
	% of Total	40.0%	26.3%	33.8%	100.0%

Source: Data is collected from the own survey in 2009.

5.9.5. Source of information about innovation from local authorities

One of the other important sources for information on innovations is local authorities. The data showed 96% of respondents (82/85) believed this source to be the case. Despite local authorities are being responsible for administrative issues, they do participate in managing the agricultural production both directly and indirectly. Within 82 respondents, 67 respondents considered that information about innovation provided by local authorities was

quite effective. As well as extension services, the information provided by local authorities does not focus on non-technical issues, i.e. information about new procedures of management. Together with extension services, local authorities also introduce innovations to farmers, support farmers in contact with suppliers, and supervise the quality of inputs and are the first place to receive feedback of farmers about the quality of innovations. The way by which local authorities disseminate information is diverse, for example, using the local radio networks, meeting farmers, implementing socio-economic programs, or assigning tasks for local association of farmers. This trend is also observed by the feedback given by farmers on locations, gender and educational levels.

Table 5.73. Crosstabulation of "Information getting from local authorities" and "location"

		Location			Total
		Haiphong	Thaibinh	Hungyen	
very inefficient	Count			1	1
	% of Total			1.2%	1.2%
Inefficient	Count	2		1	3
	% of Total	2.4%		1.2%	3.7%
Normal	Count	5	2	4	11
	% of Total	6.1%	2.4%	4.9%	13.4%
Efficient	Count	19	14	17	50
	% of Total	23.2%	17.1%	20.7%	61.0%
very efficient	Count	7	6	4	17
	% of Total	8.5%	7.3%	4.9%	20.7%
Total	Count	33	22	27	82
	% of Total	40.2%	26.8%	32.9%	100.0%

Source: Data is collected from the own survey in 2009.

5.9.6. Source of information about innovations from agricultural firms

The data from the survey showed that only 42% of respondents (36/85) evaluated that innovation was also transferred through operation of agricultural firms. The remaining 58% (49/85) said that they did not have any contact with firms even though they knew the existence of such firms in the region. Within the respondents, only 4/36 (11%) cases considered that this source is useful.

Table 5.74. Information getting from agricultural business by locations

		Location			Total
		Haiphong	Thaibinh	Hungyen	
very inefficient	Count	17	3	10	30
	% of Total	47.2%	8.3%	27.8%	83.3%
Normal	Count	2			2
	% of Total	5.6%			5.6%
Efficient	Count	1	1	1	3
	% of Total	2.8%	2.8%	2.8%	8.3%
very efficient	Count		1		1
	% of Total		2.8%		2.8%
Total	Count	20	5	11	36
	% of Total	55.6%	13.9%	30.6%	100.0%

Source: Data is collected from the own survey in 2009.

This evaluation shows that the expectation of managers to improve the efficiency of transfer to farmers through the participation of agricultural firms has not been achieved. There are many reasons for this; however, it mainly depends on two factors; the objectives of firms in cooperating and the scale of cooperation between individual farmers and firms. Regarding the objectives of firms, they are generally working to gain the highest amount of profit. The other objectives such as enhancing the agricultural production in the region, or improving knowledge and skills of farmers in the region are only embedded subsidiarily as if profit of firms was achieved. Therefore, firms invest only in items they think those would bring returns and farmers can be easily ignored if the expected profit is not reached. In reality, the changing nature of the market, especially within the international markets for agricultural products has influenced firms leading to changes. Although some forms of cooperation between farmers and firms has been seen, where farmers are assigned a certain amount of capital, fertilizer, seed, and technical support in reality, many difficulties have emerged which still need to be solved.

On the other hands, if the scale of cooperation between farmers and enterprises is still modest, it will not influence the agricultural production of farmers significantly. As such, it could not change the traditional behaviour of farmers or enhance farming production. In fact, the application of new techniques has only occurred within a part of production or for only specific products.

Box 5.6. Difficulties of agricultural enterprises in cooperation with farmers

According to information of Forum of Enterprises, the investment of agricultural enterprises into rural areas has emerged many difficulties.

- Almost agricultural products of Vietnam are produced and harvested following very much to seasonal constraints. Therefore, this feature has influenced to productivity and output of agricultural enterprises, even the output of enterprises is not stable following to the unstable of materials supplying. Besides, farmers with small-scale production without any linkage, could not produce diversified products with a great amount as requested by enterprises.
- Farmers try to harvest as much as possible, in other words, they will try to invest intensively any times out of the season. In order to do that, farmer may use many ways to achieve their highest yield in a shortest time, even they do not care to inject, or spray stimulated chemicals to plants. Therefore, the final products contain a lot of chemical residues. Meanwhile, in the context of joining to international market officially, enterprises do need clean materials for their production. This fact would negatively impact to competitiveness of products. Even the perception of farmers in growing diversified plants in their garden has also influenced greatly to the demand of enterprises for intensive products for big markets.
- Although enterprises have invested a lot for farmers as seeds, pesticide, facilities and technology, etc., and assigned a cooperation contract to cover all products of farmers, but farmers only sell these products to enterprises if the market price is lower than enterprises' price. If other competitive wholesalers provide a higher price, then farmers would go to these wholesalers. Consequently, in order to ensure the production, enterprise should buy materials from wholesalers with much higher price. This situation happens popular in the reality but lacking of measures to adjust the behaviour of farmers in breaking the contract.
- Enterprises have invested a lot in machinery, training courses and support for farmers, etc., but still not receive any support from state such as tax reduction.

Source: www.dddn.com.vn

Therefore, potential changes are only possible in these areas/products and has not influenced the remain production of the farm. More recently firms have been negotiating with farmers to try and do business together through signing contracts. After a contract has been signed (as mentioned in the above box) enterprises have provided many items such as fertiliser, pesticide, financial support, technical guidance and so on, to farmers. However, a

number of difficulties have arisen during this process such as farmers do not sell products to firms if the market price is higher, or firm's do not collect products as agreed because the price of final products has rapidly decreased.

Box 5.7. The Decision 80/2002/QD-TTg and the Decree 61/2010/ND-CP

The Decision 80/2002/QD-TTg of the Prime Minister includes 10 articles on encouraging agricultural enterprises to sign a contract with farmers to purchase farmers' product, and provides initiatives for enterprises to do that job. The incentives for enterprises include land use policy, investment in infrastructure for building material zone, credit policy, promotion for transfer innovations to farmers. In addition, the Decision also gives initial measures in dealing with dispute arising over the implementation.

Recently, the Decree 61/2010/ND-CP includes 16 articles on encouraging agricultural enterprises to invest in agriculture and rural areas. Three forms of projects have been pointed out in the Decree, including projects with investment in special priority, projects with investment in priority, and projects with encouraging investment. Incentives will be provided basing on a list ranked by level of priority, focusing on issues of reduction in land use/hire fee, supporting for hiring agricultural land of households, supporting for human-resource training, providing information about market, providing consultation, supporting transportation fee, and supporting for applying innovations.

These two policies have supported enterprises complementally to invest in agriculture and rural areas, and encourage them in underwriting agricultural products, promote a modern agriculture towards commodity production.

Some measures have been submitted, such as using third party organisations as insurance, or signing a flexible contract that allows for adapting to changes or involving local authorities. These measures have proven to be effective in some cases, for instance, avoiding the hold-ups in production. These difficulties require action from the state to adjust the relationship and to promote business enterprises investing in rural areas and agriculture. As such the decision 80/2002/QD-TTg of the Prime Minister was promulgated in 2002 through the policy for consuming agricultural products through contracts, and through a Decree 61/2010/ND-CP in 2010 on encouraging investment in rural areas and agriculture is issued. These policies have solved some difficulties which have arisen in practice. In particular, Decree No. 61 also highlights incentives for enterprises to invest in technological research, which can be applied in agricultural production. This mechanism allows the first step to open up the application of S&T in agricultural production towards

sustainable development in rural areas, in which "scientists research good plant and animals; the State organises and implements support policies; strictly, for a modern agriculture, and enterprises will invest and lead the market".

5.9.7. Source of information about innovations from R&D organisations

Analysing the feedback from farmers on the effectiveness of information about innovations in agriculture provided by R&D organisations has revealed a low respondent rate, meaning farmers are not really concerned with this source of information. Only 39 respondents (46%) provided information on this evaluation. Within these 39 respondents, only a small number of farmers were in direct contact with R&D organisations.

Box 5.8. Achievement in providing new varieties of rice to market

Applying achievements of S&T in order to improve the productivity and quality of crops plays an important role nowadays. Many achievements of research projects have been generated such as advanced seed as well as modern methods in cultivation, and their broad application by farmers has contributed to the strong development of paddy rice in Vietnam. From 2006 to 2008, many new rice varieties generated by the Vietnam Academy of Agriculture Science have been disseminated in many regions of Vietnam. Typically, the new rice variety P6 with high content of protein has been grown broadly in over 60 thousand hectares in Haiduong, Hanoi, North Central region, that brings back a crease of 150 billion VND estimate in compared with old Q5 variety. The other varieties DB6 and DB1 with high productivity in shorter time have been cultivated in the areas of over 30 thousand hectares in RRD and Central Coast region, where their productivity in Spring season has reached 7-7,5 tons per hectare, bring back a profit of 70 billion VND estimate. The other varieties SH14, X26, SH63 for the season of late Spring and early Winter might be replaced for Khangdan 18 and Q5 with high-quality rice, immunity with pest and diseases, the productivity in around 6-7 tons per hectare, higher prices 20-30% in compared with normal rice varieties, bring back an increase profit 3-5 million VND per hectare. Besides, the organization also produces seed and provides annually over 200 tons of rice seed of DB5, DB6 to farmers in Vietnam. 'A lever' of rice; Vietnam Academy of Agricultural Sciences, published on 4/1/2009

According to an article on http://vaas.vn/news_details.asp?newsID=NEW_092704072101

Table 5.75. Evaluation of farmers views on local news and information system

		Location			Total
		Haiphong	Thaibinh	Hungyen	
very inefficient	Count	16	3	10	29
	% of Total	41.0%	7.7%	25.6%	74.4%
Inefficient	Count	1		2	3
	% of Total	2.6%		5.1%	7.7%
Normal	Count	2			2
	% of Total	5.1%			5.1%
Efficient	Count	2	1	2	5
	% of Total	5.1%	2.6%	5.1%	12.8%
Total	Count	21	4	14	39
	% of Total	53.8%	10.3%	35.9%	100.0%

Source: Data is collected from the own survey in 2009.

Box 5.9. On the appearance of hybrid maize LVN61

On 28/05/2010, the Director of the Department of Cultivation (Ministry of Agriculture and Rural Development-MARD) has signed a decision 158/QD-TT-CLT to approve officially a new variety of hybrid maize LVN61 of the National Maize Research Institute (NMRI). This hybrid maize LVN61 has also been guaranteed by the guarantee certification Nr. 33.VN.2010 signed by the Vice Minister of MARD on 10/03/2010. LVN61 has been transferred to the Company for Consulting, Investment and Development of Maize (CCIDM) according to the decision Nr. 25/QD/VNCN of the Director of NMRI on 15/03/2009. CCIDM is a unique enterprise that is allowed to monopoly produce LVN61 and do business with this variety in the whole territory of Vietnam. LVN61 has a high uniformity, broad adaptability, high yield, good quality, disease resistance, hardly to be broken. Currently, LVN61 widely planted all over the country and some countries as Laos, Cambodia and some districts of Guangxi and Yunnan - China for very good results. From 2009 to present, CCIDM has held several conferences to promote LVN61 and to make LVN61 occupy a large market share in key corn markets. In the market (South East and Highlands), the fake LVN61 produced by some local farmers and local organizations with self-package has been available in the market. “On the appearance of hybrid maize LVN61”, electronic website of NMRI

According to an article on http://nmri.org.vn/tabid/59/id/50/Default.aspx

Almost all of farmers who did have a contact with R&D organisations were as a result of using innovative products, which are sold in the market as new seeds and bio-chemical additives. Thus, there is no real connection between farmers and R&D organisation as evaluation of farmers' side that might cause difficulties for R&D organisations to get feedback from users as well as receiving orders from customers. This statement is supported by statistical data, which shows that 34/39 respondents (87%) stated that this source of information was ineffective.

5.9.8. Source of information about innovations from friends, neighbor, relatives

Table 5.76. Cross-tabulation of "Information getting from friends, neighbours, relatives" and "Educational level of the head of household"

		Educational level of the head of household				
		simple reading, writing and calculating	Graduated Primary school	Graduated Secondary school	Graduated High school	Total
Very inefficient	Count		1	6	2	9
	% of Total		1.6%	9.4%	3.1%	14.1%
inefficient	Count		2	5	2	9
	% of Total		3.1%	7.8%	3.1%	14.1%
Normal	Count			7	2	9
	% of Total			10.9%	3.1%	14.1%
Efficient	Count	8	9	6	5	28
	% of Total	12.5%	14.1%	9.4%	7.8%	43.8%
Very efficient	Count		1	6	2	9
	% of Total		1.6%	9.4%	3.1%	14.1%
	Count	8	13	30	13	64
	% of Total	12.5%	20.3%	46.9%	20.3%	100.0%

Source: Data is collected from the own survey in 2009.

Examining the evaluation of farmers on the effectiveness of learning from relatives, friends or neighbours to apply innovation in agricultural production has revealed a high rate of respondents (64/85), in which, 37 respondents considered that this source of information was rather useful in compared with other sources, i.e. from R&D institutes or from firms. In the reality, communication among farmers is very popular, and it is also supported by

thousands of years of historical development of agriculture, with a close relationships among relatives, neighbour in the rural community. Visiting, communicating and exchanging information among farmers happens frequently during leisure time. From those communications, many stories have been collected, discussed, and developed to add more experiment to farmers themselves. Farmers might learn from each other such as the way of how to apply a new thing, how to solve emerged problems. By that way, S&T's achievement would be disseminated among them.

If innovations are disseminated in such communication, it seems to conclude that their effectiveness would be very high. In order to take advantage of such communication, many associations recently such as clubs of interest, forums for agricultural discussion in rural areas, women's unions and youth's unions have been established and take an active part in discussing the application of innovations. These models would be more effective, if other supports as models for visiting and training in different locations are available, or solutions for solving difficulties such as the market for output, and so on, are suggested.

Box 5.10. Applying biological food in pig farm recently

For the first time, farmers in Hanoi have a chance to test a clean farming technology in livestock, reducing environmental pollution, and in particular, meat's quality is surprisingly tasty. Recently, in a visiting to a friend, Mr. Ta Van Hung in block Tan Nuong, Hien Ninh commune, Soc Son district, Hanoi has heard about biological food for livestock of Mr. Ta Hung Dau (Chief of Extension station in Phuc Yen, Vinhphuc) that appealed Hung to test in his pig farm. "The growth rate of pigs fed with biologic food is nearly equal to pig fed by normal industrial food, but they are strong without any diseases. Pigs fed by normal industrial food will be easily to recognize as featured by red skin, expansion butt, bulky moving as drunkards and their shit is very special... rotten. If a small piece of shit stuck to your hand, so despite washing with soap several times but rotten could not disappear. Pigs fed by biological food can move fast, even they can easily jump over a lower door. In addition, their excretion and urine are not so smell". As in the same place in Tan Nuong block, Mr. Duong Van Hanh used to be an experienced livestock farmer, is using biological food for his 19 pigs, said that: "Pigs fed by industrial bran is easier to be sick. Their excretion, urine is seriously pollution, especially in the summer despite making bio-gas. Moreover, pork from industrial feeding is usually smell, not tasty like pork from biological feeding. This time is the fourth I do feed my pig with biological food but I do not need to pay for veterinary medicines, very leisurely". Mr. Hanh stated confidently:"With biological food, I still keep our livestock farm going on even suppliers do not pledge to buy our pigs, because at the end, with such method of farming, the effectiveness is higher than the method of feeding pigs with

industrial food. Previously, my pigs occasionally got a disease, when they were going to growth up but suddenly in one day, one by one, they jumped into wall and died. However, with biological food, I have never met this situation again. According to Mr. Nguyen Van Chi, director of the Department of Extension Services in Hanoi, in near future, the local authority in Hanoi will support for such movement to feed pigs with biological food, at the beginning, the number of pigs might be 150-200 pigs. The source of these medicine foods would be chosen from Northern Mountainous areas, and other additives should be the best-quality ones. Duong Dinh Tuong, some special methods of Hanoi's agriculture, published on 27/02/2012, Vietnam Farmer's Union, (According to Vietnamese Agriculture-NNVN)

According to article on http://nongdan.vn/channel.aspx?Code=NEWS&NewsID=40256&c=24

5.9.9. Source of information about innovations from local associations of farmers

Table 5.77. Crosstabulation of "Information getting from local association of farmers" and "location"

		Location			Total
		Haiphong	Thaibinh	Hungyen	
very inefficient	Count	1		1	2
	% of Total	1.6%		1.6%	3.3%
Inefficient	Count	1		1	2
	% of Total	1.6%		1.6%	3.3%
Normal	Count	7	2	3	12
	% of Total	11.5%	3.3%	4.9%	19.7%
Efficient	Count	18	6	17	41
	% of Total	29.5%	9.8%	27.9%	67.2%
very efficient	Count	1	2	1	4
	% of Total	1.6%	3.3%	1.6%	6.6%
	Count	28	10	23	61
	% of Total	45.9%	16.4%	37.7%	100.0%

Source: Data is collected from the own survey in 2009.

Further analysis on the role of farmers' associations in rural areas in providing information about innovations to farmers in the locality, the evaluation of farmers has revealed a high response rate (61/85), in which 45 respondents (74%) considered that these organisations provided helpful information about innovations. This rate is quite high and shows the

important role of these organisations. Most of the respondents have a contact with local associations and, therefore, confidence can be placed in this feedback.

Further to this, no clear difference when examining the factors of gender, educational grades between groups of farmers were found. This means that information about innovation is equally disseminated to all of members of these associations. In reality, almost all communication between other partners to farmers at locality is conducted through the co-ordination of these organisations. Recently, some of the associations of farmers have been assigned official tasks and missions, as such, they might represent their members in signing economic contracts with partners.

Box 5.11. Operation of an agricultural service cooperative in RRD

The An Duc Agricultural Service Cooperatives in Ninh Giang district, Haiduong has been established since 1960 and converted to service cooperatives in 1998. Currently, the cooperative has five managers and executives, 27 members and operated as an agricultural service cooperatives. An Duc cooperatives has the charter capital of 234 million VND, doing services in 5 sectors: irrigation, applying technical advancement; supplying inputs for agricultural production; transfer technical advancement; building demonstrative models; as the wholesaler for farmers in the locality. In 2010, the cooperatives' revenue reached 250 million VND. An Duc cooperatives has enhanced the dissemination of new technical advance to its members, encourage it members to restructure plant structure, to replace old rice varieties by new ones with advantages in higher quality, shorter growing time, or to produce other high-profit plants as zucchini Nr.1, maize VN10, MX10, potatoes VT3, hybrid rice P6, Nangxuan, two-line hybrid rice TH3-4, T10, etc., together with application of new machines for direct rice sowing with a modern rig. In 2008, the cooperatives had only two machines, but now it has seven machines. These applications of innovations has improved the productivity of rice in the locality to seven tons per hectare in Spring-Summer season, and 6,7-6,8 tons per hectare in Autumn-Winter season. An Duc cooperatives has actively cooperated with high respective seed companies to provide high-quality rice seed for its members. In 2010, the cooperatives has sold nine tons of rice seed, 1,7 tons of potato seed, 340 kgs of maize seed and 70 tons of fertilizer.

Source: Nguyen Thi Thuan, S&T Journal in Haiduong, Nr. 5/2011.

6. CONCLUSIONS AND RECOMMENDATIONS

Through the above five chapters, readers can see that an interdisciplinary analysis has been used to answer the research questions and derive recommendations and suggestions. Regarding the content of the thesis, the first three chapters have presented theoretical definitions, arguments, perceptions of related issues, and methodologies of the study. The last two chapters have focused on empirical research in the research region. Assumptions have been provided to give focus points for attention of readers.

The conclusions will summarise the findings basing on the analysis through previous chapters. In the part of recommendation, I would present suggestions for the situation to encourage the process of transferring innovations to farmers as well as applying innovations in agricultural production of farmers throughout the region. The resommendation should come from practical analysis and rely on the fundamental principles for transferring innovations to farmers, which will be clarified in the next parts.

6.1. Conclusions

Considering the main research question of this study: "How can people improve the transfer of S&T achievements to farmers", it is answered by several analyses through five chapters. In conclusion, it is clear that the interference should be in conformity with the characteristics of farmers throughout the region, the institutions in the rural areas, the characteristics of innovative advancements, in order to satisfy the increasing demand of market in a modern production towards commodity economy. In concrete situations, the interference plays a supporting role in terms of providing credit for applying innovations, or through diffusing advanced techniques, or building demonstrated models for visiting and training, or issuing regulations as VIETGAP for a better production. Systematically, these issues can be answered following several sub research questions:

- What are the implications of implementing S&T in agricultural production, and how are these implications perceived by farmers?

For this question, the study considered the role of S&T in the process of agricultural development within the RRD, the influence of applying innovations in reality, as well as the recognition of all social entities including local authority. After that, in a section discussing on theoretical perception of innovations, this definition has been analysed from four main perspectives: from the economic perspective, from the technological perspective, from a managerial perspective and from other perspectives such as marketing's point of

view. This section was also concerned with the theoretical conditions for applying innovations as well as characteristics of an applicable innovation in details. The most important characteristics of an applicable innovation are the commercial capability, observability, trial-ability, compatibility, complexity and relative advantage. The study has also discussed the necessity of applying innovations in agriculture. Many expectations have been concerned as the positive results from the process of applying innovations in agricultural production.

- For the next research question: Who are the actors responsible for transferring S&T achievements to farmers, and what are the linkages between the relevant actors?

The study implies that the adoption of innovations in the research region is a chain, where different partners are involved to transfer innovative advancements from the group of creators of innovative advancements to groups of users through the support of intermediary organisations. The related issued such as capability and features of each group, their behavioural activity, their linkages in the research region has been analysed. Many conclusions can be made regarding the capability of farmers and other partners in transferring innovative advancements and applying innovative advancements in agricultural production within the region. The study also analyses the implications behind a decision of applying innovative advancement of farmers throughout the region. Many issues regarding the level of education of farmers, their capability of land possession, geographical feature of residential location have emerged. In order to attract the attention of readers, the study has made a number of assumptions. For instance, in order to evaluate the influences of indigenous factors on the process of transferring innovations to farmers, the study has assumed "the personal characteristics of farmers themselves would impact on the process of applying innovation in agriculture. These characteristics may encourage or discourage the process" (Assumption 1). In this assumption, the issues such as being " younger and wealthier then intends to apply innovation, precisely", or "May be more educated then precisely they have more capability in applying innovations", or "Whether, more wealth in finance then they intend to invest for innovations", or "The relation of gender and application of innovations, may be extension agents should consider the process of approaching to farmers via a group of women or ...", or "Whether with greater land possession then more innovations are able to be implemented ", or "Whether, there is a relationship between equipped machinery and capability for innovations". Several conclusions have been made referring to these topics such as "an improvement in

education and training level of farmers is needed. The form of vocational training provides farmers with examples of the conditions for modern production towards commodity production. In addition, training courses following the demand from farmers should also be encouraged to provide sufficient knowledge for farmers. Further to this “credit support is required for applying innovations in farmers' household", and "providing favourable conditions for collecting and gathering agricultural land, resources for farming would create many new farms towards commodity production where farmers apply innovations in their production. Such farming models would receive more support from state programs, because they satisfy the conditions of these programs". In addition, "a channel of gender approaching should be taken into account to improve the efficiency of diffusion when approaching farmers in the rural areas to transferring agricultural innovations".

- For the questions of: "How can we encourage the co-operation of actors involving in the process of transferring S&T achievements to farmers?", and "What factors constrain this process and how can we overcome these difficulties?"

In order to evaluate the availability of sources of S&T advancement/methods for innovations in agriculture, the study assumed: "In fact, information about innovations in agriculture is available but still far below the demand of farmers. The reason behind this may be less awareness among farmers of innovations as well as some constraints of ability in approaching the innovations". When discussing the forms of approaching farmers and farmers' exception of the suitable forms, the study assumed: "There are many forms of approaching farmers, but the most successful model should be originated from the demand of them". Further to this in order to evaluate the consideration of farmers on competitiveness of products those are from application of innovations and others, the study assumed: "Farmers in a modern agricultural production should know how to choose options that are best fitted to the expected profit in comparison with other products". In addition, the study assumed that in order to evaluate the ideas of farmers about supporting programmes for applying innovations in agriculture, "support for agricultural production as a whole and for applying innovation in agriculture as in particular is still needed nowadays". Focusing on the effectiveness of contacting farmers to transfer innovations, the study assumed: "the way of contacting with farmers decides the effectiveness of the linkage and would reveals the result from the beginning of the process"; or "The content of the process of transformation would decide the way of communication and introduction, by forms as theoretical introductory, visiting and training, vocational training, through an

intermediate organization, ...". The related conclusions have been presented in the closing session after each of the above analyses.

Following conclusions focuss more in the situation of the study.

- Applicable S&T achievements in agriculture include not only technological inventions but also innovations in management as strategy innovation, organisational innovation, process innovation. However, the transfer of S&T to farmers in the RRD is currently focusing much on technological issues without concerning to the other innovations. In order to promote the transfer of remained innovations, a system of solutions should be carried out relating to all aspects as mentioned in the analysis, for example emphasing on the active participation of recipients and the linkage between actors or environment for establishing such relation. In addition, promoting the awareness of farmers on innovations by communications program daily, weekly, monthly, seasonally would be positive.
- Most farmers recognise the advantages of applying innovations in production, but they still play a passive role in the process. Only small part of farmers participate in the process actively: they are well educated or rich experience farmers.
- For farmers with small scale of production, the application of S&T in agriculture is considered as simple job because they are intersted only in some technical issues such as new varieties of crops or new fertilizers. These applied technologies are only focussing on specific issue. However, in a large scale production, finding a solution as a whole to improve the production is not simple and require alot of effort as well as resources. Only rich experiment farmers of well educated farmers can do so.
- Due to their limitation in education and training, financial capacity (as indicated in the analysis of endogenous factors), or difficulties in market of input/output, quality of inputs, natural disaster (as indicated in the analysis of exogenous factors), farmers are constrainted in applying new things or getting benefit from applying new thing. Solutions for these situations seem to be not a task of science and technology management but also the task of other managerial fields. Solution might focus on encouraging the willingness of farmers in applying S&T in agriculture by providing incentives regarding credit policy, financial support,... to restraint the

limitations of lacking knowledge, lacking innovation‘s information, fragmented agricultural land...

- Approaching to farmers might be conducted under different forms, and there are also many available approaches in transferring S&T's achievement to farmers, but the most efficient approach should base on cultural characteristics as well as involving farmers as much as possible. In these approach, favorable channel such as women association, or local young union, and so on, as well as other supporting from local extension service, local authority, television program would be favorable in the process.
- Providing information about innovation actively to farmers would also be very important. In the process, the active role of local extension service, local infomation system, extension programs on television play an important role, while encouraging farmers to learn from theirr neighbors, relatives through favorable forms such as word-of-mouth is also positively contribute to the sucessfull of the transfer.
- In the process of transferring innovation to farmers, the suppliers of innovation and intermediaries organisations need to be more flexible rather than playing a passive role. They need to be regulated as free partners, together with incentives not only direct support but also indirect support in creating favorable environment for research and cooperation with other partners. For example, cooperation between extension service and enterprises in providing innovations to farmers would be a good example.
- In the application of innovation, other factors of infrastructure, capability of extension service, local authorities in managing inputs, system of standardisation to adapt to requirement of increasing demand for products with certified quality, and so on also influence to the result of the process. Therefore, a suitable strategy to invest in such factors would also positively contribute to the efficiency of the process.

6.2. Solutions and Recommendations

From the analysis and derived conclusions, solutions and recommendations have been presented to adapt to requirements. As such those solutions and recommendations should

be in line with principles of the transfer of innovations to farmers throughout the region. Concretely, the basis for such solutions and recommendations should be:

- The development trend of agriculture throughout the region in a context of integration into international standardisation;
- The current situation of agricultural production within the region as well as the real activity of transferring innovations to farmers throughout the region that are analysed in the above four chapters of this thesis;
- The political-will of local authorities and related policies in terms of transferring innovations to farmers and encouraging farmers to apply innovations in their production;
- The willingness and capability of all partners involved directly in the process of transferring innovations to farmers and applying innovations in the productions.

Thus, these above bases are also the suggestions for next writing.

6.2.1. Principles for transferring innovations to farmers throughout the region

Principle 1. Encouraging the participation of all partners in the process

There are two types of solutions: "pull solutions" or "push solutions". Solutions following to this principle should be in accordance with these types.

With this principle, solutions for concrete type of partner would be different. For instance, for end users such as farmers, their dynamics to apply innovations in their production is mostly concerned with two issues that have emerged from the analysis in previous four chapters: (1) market for agricultural outputs, and (2) actual information about farmers whose success in applying innovations in their production is well-known. Therefore, solutions to develop market of agricultural output will affect mostly farmers, leading to the development of applying innovations in agricultural production to satisfy demand of the market.

For suppliers of innovations, their dynamics would be the profit from the transfer of innovations, or under administrative management, or opinions and reputation of others scientists.

Principle 2. Farmers should be considered as a central subject of the process

In fact, in the context of rapid growth of S&T, currently, there are many organisations and individuals to participate in the chain of providing and transferring innovations to farmers. Thus, the potential suppliers of innovation are relatively abundant. As such attention should be paid only to adapt the supply in accordance with demand of farmers. In other perspectives, promoting the autonomy of farmers in receiving and applying innovations should be the motto of actors involved in the transfer of innovations.

Hence, the transfer should start at "demand", or "demand" should be considered as a basis for the transfer. According to this argument, the formalism type of transfers done by state extension services should be eliminated. In replication, organisations of farmers in the locality should represent their members to submit their request to extension services. On the other hand, the suppliers of innovations should respect the aspiration of farmers and consider their requests as the central points in the process of transfer. To ensure the success of the transfer, suppliers should actively exploit the willingness of farmers in terms of the type of innovations and their quantity, quality, time of application, conditions of transfer and others. These adaptations suppliers would guarantee to avoid unexpected failure and risk, especially risk for farmers.

Moreover, the acceptance of farmers and commercial value of output should be considered as important indicators to measure the success of a transfer. As such, satisfying the demand of farmers for innovations should be considered as a central issue in the process of transferring innovations to farmers. The decision made by farmers to apply an innovation is mostly derived from an expectation of gaining profit. Thus, only innovations that can bring potential benefits such as high quality, high yield, high economic efficiency might convince farmers to innovate. Therefore, any assessments made should be clear, practical and quantifiable, not like previous assessments, which were formal and without clear responsibilities for both transferees and receivers. Pursuant to this, farmers would receive what they need, and transferees would find an appropriate plan for the transfer.

Principle 3. Contributing to the improvement in building capacity of involved partners

- For farmers: It is necessary to develop the skills of farmers to carry out intensive farming as quickly as possible, on the basis of combining traditional experiments and applying innovations in agricultural production. Currently Vietnamese farmers' understanding of technical proficiency is fledgling; however they have a rich

knowledge about traditional production. Therefore, respect for their experiment would enable farmers approaching innovations in a natural sense, closer and more receptive. This approach would exploit the potential of farmers in the region, promote the local knowledge.

- For creators of innovations: Currently, most of the agricultural innovations are generated by state R&D institutions or imported from abroad. Investment on building capacity for these organisations to innovate would positively influence to the generation of agricultural innovations. Moreover, the support does not only invest for building internal capability but also promoting the linkage between creators and users of innovations.
- For intermediate organisations: The work of intermediate organisations as extension agencies should be considered as a professional career that need a better investment. This partner plays an important role in the chain of transferring innovations from creators to farmers.

Principle 4. Combining the advantages of a market economy and cultural nature of local production in the process of transferring innovations to farmers

The market economy has created advantages such as removing the stagnation of the smallholder economy and created a favourable environment for applying techniques widely in agricultural production. However, it can also cause serious harm, disrupting the regular ancient pattern if development takes place too quickly. Therefore, the local cultural identity is a "barrier" to prevent any negative effects from development of market economy. This barrier discriminates against fraudulent and deceptive activities, or limits the risks impacting the healthy life of farmers. The mechanism of markets will support farmers to get innovations quickly and, as such, it would be better, if this activity was done in association with the constraint of the factor of traditional culture. In this case, the application of innovations would connect related farmers, find out what is suitable with communities' interest, and gathering farmers against the pressures causing damage to traditional agriculture.

Principle 5. Help farmers in the region to adapt to changes in international market

Influenced by arbitrary operation of a smallholder's economy, Vietnamese farmers cannot avoid difficulties in satisfying the requirement emerging from international integration. As they are not familiar with industrial working methods without being fully aware of

international conventions especially on food standardisation and standards in production and food processing, they would encounter a number of obstacles relating to international co-operation. As such these difficulties need to be quickly overcome to allow the Vietnamese's agricultural products to enter the international market.

Thus, these above principles are not important for generating solutions in the research framework of this thesis, but they are also important suggestions for all of related agencies of Vietnam. The solutions in the next part are based very much on these principles.

6.2.2. Recommendations and solutions to promote the transfer of innovations to farmers

The real life situation is changing quickly; therefore, the potential solutions can not cover all areas and are only acceptable in certain circumstances. The solutions and recommendations given below are only relevant in the context of research topics, basing on above principles and are presented as follows:

- Deriving from the analysis in the part of empirical research, "market for agricultural output" plays an important role in supporting the activity of farmers in searching innovations and applying innovations in their agricultural production. Therefore, the first recommendation of this study focuses on this factor. The development of "market for agricultural output" will create a powerful dynamic for farmers to apply innovations in their production.

In an economy oriented towards market mechanisms, all activities relating to supplying innovations or selecting which innovations to be applied should follow to the principle of "purchase and sale agreement" between farmers and suppliers. Rules of a market economy should be respected and applied generally to promote the autonomy of farmers, remove the stagnant and inconsistent of farmers in their decision of searching for and applying innovations in their agricultural production. From other perspectives, the application of market mechanism in supplying innovations would increase the competitiveness of suppliers in such fields. The competition between these suppliers would generate benefit for farmers as their customers.

Currently, in Vietnam, due to the consequences of the previous command economy and subsidy regime, or the influence from the production of a smallholder's economy, the factor of the market is still weak, especially in agriculture. Farmers are still not ready to adapt to changes in the market, and in most cases, farmers are vulnerable to negative

effects of the output market. Further to solutions such as frequently providing farmers information regarding markets for agricultural output, or encouraging agricultural enterprises to co-operate with farmers and purchase the output from the agricultural production following to a prepared contracts. In addition, encouraging the establishment of associations of farmers in the area to increase the power of farmers in negotiating with sellers, and these organisations also represent for their members to search potential consumers. Besides this, an important solution regarding the capability of farmers in adaptation to standards of output market should be taken into account. Farmers should be informed about the details of demand in terms of technical standards, and also the way of conducting their production to satisfy those standards. From that point of view, farmers are aiming towards modern production where standards of production should be strictly followed. The approval and introduction of VIETGAP is needed in those cases.

- In addition, the attention of state and local authorities should be geared towards finding markets for innovations. The administrative management of these markets would also guarantee the quality of innovations, which will be transferred to farmers in the region. Effective management would help farmers to avoid losses caused by bad quality seed, fertiliser, pesticide, and so on. Regarding this recommendation, solutions such as enhancing the capabilities of local authorities in managing such issues, or providing information relating to technical criteria of innovations as well as enhancing the capability of farmers in recognising the characteristics of innovations, and so on, should be taken into account.
- The next recommendation focuses on the issue of encouraging the demand from farmers to innovate and stimulate them to apply innovation in their production. Theoretically, the legitimate aspirations of farmers can only be considered on the basis of improving their autonomy that supports them to look actively for prestigious suppliers. Farmers are central to the process of transferring innovations, and they should play an active role. Following to that assumption, the transferees should find appropriate plans with suitable contents under favourable methodologies to transfer innovations to farmers. Currently, as mentioned in the previous parts, the characteristics of farmers in the region are specified by small scale production, fragmented production, and nearly always self-satisfied with their own small successes. Therefore, the solutions should focus on issues such as Encouraging the capability of farmers in the region in terms of consolidating

agricultural land or organising vocational training to provide related knowledge, promoting the diffusion of innovations to eliminate stagnation in the mind of farmers, or conducting development programs on to create a new modern agriculture and changing rural areas' appearance effectively. These solutions might be included in the current program on building new rural extension programs, communication programs on adoption, and especially through the diffusion of successful T&V model. For instance, the program on creating new rural programs was established through the resolution Nr. 26 At the 7th session of the Central Committee of the Communist Party of Vietnam (X), August 5th, 2008 where the issues of three agri-definitions (agriculture, rural and farmers) were discussed. As a result of this resolution, the Prime Minister approved a Decision 491/2009/QD-TTg on 16.04.2009 on the National Criteria for New Rural, and the Ministry of Agriculture and Rural Development has issued the Circular 54/2009/TT-BNN on 21.08.2009 on the Guideline for the Implementation of the National Criteria for New Rural Programs. These documents contain important guidelines for the development of agriculture, rural and farmers. Therefore, the good implementation of these programs should provide a good basis for the solution following to this recommendation.

- The capability of all partners involved to transfer innovations to farmers needs to be improved. Therefore, the actors including farmers as end users, the extension agencies, local authority as intermediate organisations, R&D institutes as creators of innovations should invest to improve their capability in recognising and applying innovations in productions. The other related organisations such as agricultural enterprises or NGO organizations should also need favourable initiates to encourage the transfer of innovations to farmers. The solutions according to this recommendation might focus on issues:

With the respect of farmers, vocational training, short training courses, visiting demonstrated models, or specific training to provide information directly to farmers is necessary. Besides this, information on innovations should also be transferred to farmers through mass media programs as well as through the operation of local associations of farmers, and unofficial channels as friendships and relatives. In order to ensure the success of the adoption of innovations, innovations should be introduced to farmers through favourable groups such as young groups, women groups and interest clubs. These solutions

should approach farmers from different angles in order to create a movement in the rural areas concerning to apply innovations in agricultural production.

With regards to extension services the solutions focus on initiatives to improve the skills of extension workers by training and retraining, investment in facilitation and provide accommodation for the activities of transferring innovations to farmers. In some cases, an annual competition between extension staffs to become qualified should be a solution. In addition, accommodation for this staff should be equal to their labour. This support might not only direct supports, but also indirect support for them to look for cooperation with other partner as agricultural enterprises to transfer innovations to farmers. The favourable initiatives to encourage the autonomy of extension staff and open the co-operation would create strong dynamics for the operation of these staff[23]. For R&D institutes, initiatives to improve the capability of R&D are a complex combination of R&D policies and policy specification covering agriculture and rural development, including major issues as financial policies, organisational policies, manpower policies, mechanisms for innovations policies, and others

- In order to provide the right innovations to farmers an evaluation of the demand from farmers for innovations, in which content of evaluation, criteria for evaluation, the methodologies for evaluation as well as the objectives of the evaluation and the influence of time needs to be considered. Further to this the factors of location in comparison with other relative information should be taken into account. The previous analysis has revealed that the adoption of innovations will have a great chance to be successful if it originates from farmers.
- Further to this investment in infrastructure is necessary. The investment in infrastructure could consider the following factors in this order of priority: local transportation, local electricity, irrigation system and news and information

[23] In the session 5.7, a solution has been pointed out: "the government should conduct a program to allocate state funds for encouraging such rational cooperation between enterprises and local extension agents. In addition, local extension agents need to identify their customers, not only farmers as traditional customers but also the new agricultural enterprises as potential customers. Agricultural enterprises are not only potential customers of extension agents, but also a potential provider of funding for extension services. Maintaining the relationships and cooperation between extension service and agricultural enterprises would be a solution to further promote agricultural development in the region towards a highly modern production focusing on specializes in commodity production. A state program with state budget allocation might be implemented under authorization management of a fund, focusing investment mainly for the extension agencies and R&D indirectly, but through the operation of eligible agricultural enterprises with necessary requirement (for example, the record of enterprises should be in appropriate field, satisfying requirement of historical experience since establishment, and so on)."

systems. This order does not mean the important role of each issue in the production but rather that the current condition of infrastructure in the region needs to be invested in. For instance, irrigation systems are the most important factor for paddy rice production; however, recently there has been a lot of investment in this area and the infrastructure is now considered to be in a quite good condition. Despite this the current demand from farmers to enlarge their production to large scale production, and as such more investment in transportation is required.

The investment in infrastructure should be carried out within a clear planning structure and connected with the program on building a new rural, under the motto "State and people working together".

- Regarding the way of transferring innovations to farmers the attention on the form of the transfer, the procedures of the transfer and methods of the transfers is recommended. Further to this recommendation the following solutions are needed: (1) to enhance the linkage between farmers and suppliers of innovations; (2) to define the principle of behaviours between partners and mechanisms to solve the conflict happening in the process; (3) Learning experiment from successful cases and unsuccessful cases.
- With reference to the process of integration to international standards, the agricultural production of Vietnam should adapt to the standardisation of others in the world. This issue is currently not understood by the Vietnamese government and also should be accepted by all farmers in the region. The understanding of farmers on international standards will help their products gain a competitiveness to producers outside Vietnam. In other ways, applying standardisation in production would change the production to a more modern one towards commodity production, where the application of innovations plays an important role.

Finally, this study "Interdisciplinary analysis and assessment of transferring S&T achievement to farmers (case study in the RRD)" has been an interdisciplinary analysis, covers a very complex issue. Although it has been limited by concentrating on the Red River Delta region where the development of infrastructure, the local agriculture and other issues such as culture, population are homogenous as well as the linkage between the agricultural, industrial and service sectors is quite close within the economy. I hope that the analysis conducted within this study provides a positive contribution to the development of agriculture within the region./.

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APPENDIX

Questionnaires for survey (for farmers)

These informations will be coded and only be used for the research purpose of evaluating the application of "innovation" in farmer-household. These informations should not be used for other purposes.

Thank you very much for your participation and cooperation!

I. GENERAL INFORMATION

1. Date of interview *(day/month/year):* . . . . . .

2. Place of interview *(commune/district/province):* . . . . . .

3. Name of the interviewee: . . . . . .

. . . . . .

4. How is your relationship with the head of household

Spouse	☐	Grandparent	☐
Parent	☐	Child	☐

II. EVALUATING THE INFLUENCE OF INDIGENOUS FACTORS ON THE PROCESS OF TRANSFERRING "INNOVATION" TO FARMERS

5. Sex of the head of household

Male	☐	Female	☐

6. Year of Birth of the head of household . . . . . .

7. How is current marital status of the head of household

Single	☐	Married	☐
Separated	☐	Divorced	☐
Widowed	☐		

8. What is highest educational grade did he/she obtain:
What is highest educational level did he/she obtain

None	☐	Primary school	☐
Lower secondary school	☐	Upper secondary school	☐
Vocational training	☐	College	☐
University	☐		

9. How many people in the family: . . . . . .
in which the number of full-time labors: . . . . . .
the number of part-time labors: . . . . . .

10. What are the main agricultural activities do you conduct now

Plant Production ☐ Livestock ☐ Other ☐

11. Where does the income of household come from:

Agricultural production ☐ Service ☐

Wage from employment ☐ Self employment ☐

Other (specify if possible) ☐

. . . . . .

12. Estimated total revenue of household:
Yearly: . . . . . .
In which, how many percent of the revenue come from agricultural production: . . . . . .

13. Total areas for production of household, in which (m^2)
Arable land: . . . . . .
Garden: . . . . . .
Liverstock land: . . . . . .
Areas for service: . . . . . .
Others: . . . . . .

14. Current status of equipment (tools) for agricultural activities of household

	Preparational jobs	Production	Harvesting	Conservation
Satisfied equipped	☐	☐	☐	☐
Acceptable	☐	☐	☐	☐
Not satisfied equipped (please in details if possible)	☐	☐	☐	☐

Estimated value of all equipment and tools for agricultural production of household:
. . . . . .

II. EVALUATING THE INFLUENCES OF "EXTERNAL FACTORS" ON THE PROCESS OF APPLICATION OF "INNOVATION" IN FARMER HOUSEHOLD

15. Have you ever heard about application of "innovations" in agriculture, if yes, have you ever tried to apply an "innovation" in your production, if yes, would you like to talk about your application

Yes ☐ No ☐

(Explanation of the interviewer regarding the term "innovations" and the application of innovation in farmer household)

16. When did you apply "innovation" (year of application): . . . . . .

17. The name/area of the application: . . . . . .

18. Reason for applying "innovation" of yours: . . . . . .

19. Do other people do the same thing at the same time together

Yes ☐ No ☐

20. From the beginning of the process, how is the market chance for outputs of the application "innovation"

Better sale is cleared ☐ Might be better ☐

Normal ☐ Unclear and risky ☐

21. Where do you sell your products

Please give your ranking on the volume of sale (from 1 to 5)

	1 0-10%	2 11-30%	3 31-50%	4 51-80%	5 81-100%
Local market	☐	☐	☐	☐	☐
Collector	☐	☐	☐	☐	☐
Wholesalers	☐	☐	☐	☐	☐
Retailers	☐	☐	☐	☐	☐
Companies	☐	☐	☐	☐	☐
Others	☐	☐	☐	☐	☐

22. How do you mobilize the invest for the application and in your opinion, do you find any difficulties in getting credit

Please give your ranking from 1 to 5 with: 1: very easy, 2: easy, 3: not so easy but acceptable, 4: difficult, 5: very difficult

	1	2	3	4	5
Self financed	☐	☐	☐	☐	☐
Credit from family without interest	☐	☐	☐	☐	☐
Private credit from private with high interest	☐	☐	☐	☐	☐
Credit from the banks	☐	☐	☐	☐	☐
Investment from partners	☐	☐	☐	☐	☐
Others	☐	☐	☐	☐	☐

23. In your opinion, do you find any difficulties in getting new techniques and mastering these techniques

Please give your ranking from 1 to 5 with: 1: very easy, 2: easy, 3: not so easy but acceptable, 4: difficult, 5: very difficult

	1	2	3	4	5
When try to get new techniques	☐	☐	☐	☐	☐
When try to master new techniques	☐	☐	☐	☐	☐

24. What is the result from the process of application, in details please: . . . . . .
. . . . . .
. . . . . .
. . . . . .

25. What are advantages and difficulties in the process of application

Advantages	Difficulties

26. Your recommendations for a better performance of the transferring process

27. Besides, which sources of information do you often get any "innovations" in agriculture

In which, please give your ranking on the performance of them from 1 to 5: 1: very inefficient, 2: inefficient, 3: normal, 4: efficient, 5: very efficient

	1	2	3	4	5
Television, radio	☐	☐	☐	☐	☐
Newspapers	☐	☐	☐	☐	☐
Internet	☐	☐	☐	☐	☐
Extension agents	☐	☐	☐	☐	☐
Local authority staff	☐	☐	☐	☐	☐
Staff from enterprises	☐	☐	☐	☐	☐
Staff from R&D organisations	☐	☐	☐	☐	☐
Friends, Neighbors, family members	☐	☐	☐	☐	☐
Others sources	☐	☐	☐	☐	☐

28. In your opinion, do you find any advantages and difficulties as getting in touch with those sources of information

	Advantages	Difficulties
Television, radio		
Newspapers		
Internet		
Extension agents		
Local authority staff		
Staff from enterprises		
Staff from R&D organisations		
Friends, Neighbors, family members		
Others sources		

29. Which forms of collecting information regarding "innovation" have you ever conducted, please give your ranking on the *level of satisfying when you look for information and the suitability of the content of transferring*

The ranks range from 1 to 5 with: very not satisfaction, not satisfaction, a bit satisfaction, satisfaction, very satisfaction)

Please note that only answers in the question 28 are involved

	1	2	3	4	5
Television, radio, newspapers	☐	☐	☐	☐	☐
Internet	☐	☐	☐	☐	☐
Club of interests, local association	☐	☐	☐	☐	☐
request of local authority staff	☐	☐	☐	☐	☐
Guideline of extension agents	☐	☐	☐	☐	☐
Training and visiting best practices by: - organized by others	☐	☐	☐	☐	☐
- self-seeking and learning	☐	☐	☐	☐	☐
Guideline of staff from R&D organizations	☐	☐	☐	☐	☐
Following to agreement in the contract with agricultural enterprises	☐	☐	☐	☐	☐
Other forms	☐	☐	☐	☐	☐

30. In your opinion, please give your ranking on *the suitability of the way of transferring process*

The ranks range from 1 to 5 with: totally not exceptable, exceptable but better to improve, normal, exceptable, very exceptable)

Please note that only answers in the question 28 are involved

	1	2	3	4	5
Television, radio, newspapers	☐	☐	☐	☐	☐
Internet	☐	☐	☐	☐	☐
Club of interests, local association	☐	☐	☐	☐	☐
request of local authority staff	☐	☐	☐	☐	☐
Guideline of extension agents	☐	☐	☐	☐	☐
Training and visiting best practices by: - organized by others	☐	☐	☐	☐	☐
- self-seeking and learning	☐	☐	☐	☐	☐
Guideline of staff from R&D organizations	☐	☐	☐	☐	☐
Following to agreement in the contract with agricultural enterprises	☐	☐	☐	☐	☐
Other forms	☐	☐	☐	☐	☐

31. Would you give some advantages and difficulties when you create and maintain the contact with partners

	Advantages	Difficulties
Television, radio, newspapers		
Internet		
Club of interests, local association		
request of local authority staff		
Guideline of extension agents		
Training and visiting best practices by: - organized by others		
- self-seeking and learning		
Guideline of staff from R&D organizations		
Following to agreement in the contract with agricultural enterprises		
Other forms		

32. In your opinion, what do the partners do when they wish to maintain the contact with farmers

The ranks range from 1 to 5 with: 1: very bad, 2: bad, 3: normal, 4: good, 5: very good

	1	2	3	4	5
Simply providing one-way informations	☐	☐	☐	☐	☐
Encouraging the participation of farmers in looking for and discussing the problems of farmers	☐	☐	☐	☐	☐
helping farmers to master new techniques and solve problems by themselves	☐	☐	☐	☐	☐
Other opinions	☐	☐	☐	☐	☐

33. In your opinion, how is the effect of the conditions of local infrastructure on the chance of getting and applying "innovations" of household

The ranks range from 1 to 5 with: 1: very bad, 2: bad, 3: normal, 4: good, 5: very good

	1	2	3	4	5
local transportation system	☐	☐	☐	☐	☐
electricity and power supplying	☐	☐	☐	☐	☐
Irrigation system	☐	☐	☐	☐	☐
Market of inputs	☐	☐	☐	☐	☐
Market of output	☐	☐	☐	☐	☐
Local information supplying	☐	☐	☐	☐	☐
Machinery and Tools for preparational work, harvesting and conservation	☐	☐	☐	☐	☐
system of local organizations such as club of interests, local associations	☐	☐	☐	☐	☐
Extension services	☐	☐	☐	☐	☐

34. Do you have any difficulties when you sell the products

	Yes	No
Difficulties in searching for customers (lower demand)		
Low price		
Not intime payment		
Difficulties in transportation		
others (details)		

35. Do you have any difficulties when you buy inputs for the application of "innovation"

	Yes	No
Difficulties in searching suppliers		
High price		
Low quality		
Not intime delivery		
Others (details)		

36. Do you agree that applying "innovations" in your agricultural production would add the competitive power for your products in comparison with other products

	Yes	No
More chance for the output market		
Better quality		
Higher price		
Lower cost price		
Others (details)		

Thank you very much!

Questionnaires for survey (for institutions)

These informations will be coded and only be used for the research purpose of evaluating the application of "innovation" in farmer-household. These informations should not be used for other purposes.

Thank you very much for your participation and cooperation!

I. GENERAL INFORMATION

1. Date of interview *(day/month/year):* . . . . . .

2. Place of interview *(institution/district/province-post address):* . . . . . .
. . . . . .
. . . . . .

3. Name/position of the interviewee: . . . . . .
. . . . . .
. . . . . .

4. The type of the institution

Extension services	☐
Agricultural enterprise	☐
R&D institute	☐
National program	☐
Others	☐

5. Which innovations have you ever transferred to farmers

	Yes	No
Advancement in new seed		
Advancement in new crops		
Advance techniques in fowls/poultry		
Advance techniques in livestock		
Advancement in preparation jobs		
Advancement in farming jobs		
Advancement in farm management		
Advancement in pest control with minimal chemical use		
Advancement in chemical using		

Advancement in fertilizer		
Advancement in harvesting techniques		
Advancement in conservation		
Advancement in marketing method		
Advancement in mechanics		
Other advancements (please in details)		

6. Reason for transferring agricultural "innovation" of yours:

	Yes	No
This is a job/mission		
To sell the products to farmers for profit		
This is only a provision of inputs following to a contract signed with farmers for forming a material zone		
For a non-profit project		
Others (please in details)		

II. APPROACHING TO FARMERS

7. How do you contact with farmers

From the request of farmers' side *(Including cooperative, club of interest, local association of farmers, local association of woman…)*	☐	%
From the request of suppliers' side (yourself or your host-institution)	☐	%
From the request of other organizations (who are they; NGOs ☐, enterprises ☐, state agencies ☐, ….)	☐	%

Active (Direct) contact	☐	%
Through an intermediate organization *(Cooperative, club of interest, local association of farmers, local association of woman…)*	☐	%

Both ways	☐	%

8. Which methodologies have you used to transfer innovations to farmers, How often do you contact farmers (times/year)

		times
Workshop in locality with prepared presentation only	☐	
Identifying problems in locality with participation of farmers and together searching for a best-fitted solution	☐	
Visiting and Training course	☐	
Forming a best practice in farmer household	☐	
Forming a project and helping farmers to master new advancement including providing all inputs and techniques and consume outputs	☐	
Guiding, motivating and consulting the operation of local association of farmers	☐	
Others (Please in details)	☐	

9. In your experience, what are the difficulties in getting contact with farmers,

Please give your ranking from 1 to 5 with: 1: very easy, 2: easy, 3: not so easy but acceptable, 4: difficult, 5: very difficult

	1	2	3	4	5
Lack of accommodation for agents	☐	☐	☐	☐	☐
Lack of investment for tools/equipment	☐	☐	☐	☐	☐
The content of transferring is not equal to the skill level of receivers	☐	☐	☐	☐	☐
The methodology is not suitable	☐	☐	☐	☐	☐
Infrastructure as irrigation, transportation, media system, … is still under constructed	☐	☐	☐	☐	☐
Difficulties of output market	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

10. In your experience, who are potential users of innovations, which strategies have you ever applied in the process of transferring innovations to farmers

Please give your ranking from 1 to 5 with: 1: not regarding, 2: little regarding, 3: normal, 4: more regarding, 5: strong regarding

	1	2	3	4	5
More educated people	☐	☐	☐	☐	☐
More young people	☐	☐	☐	☐	☐
To be a male	☐	☐	☐	☐	☐
In good wealth status	☐	☐	☐	☐	☐
Strong capability in finance	☐	☐	☐	☐	☐
Large areas of land possession	☐	☐	☐	☐	☐
Being a member of a local association	☐	☐	☐	☐	☐
Strong willingness of applying innovations	☐	☐	☐	☐	☐
Strong power in local society	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
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	☐	☐	☐	☐	☐

11. Do you get any feedback from the application of innovations in locality? When you get feedback from farmers, how can you analyze?

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12. To what extent are technological innovations developed by lead users, rather than by R&D experts

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13. What are the main sources of innovations?

Please give your ranking from 1 to 5 with: 1: not regarding, 2: little regarding, 3: normal, 4: more regarding, 5: strong regarding

	1	2	3	4	5
Delivering from mother agencies	☐	☐	☐	☐	☐
Own research	☐	☐	☐	☐	☐
Transferring from other domestic institutes	☐	☐	☐	☐	☐
Transferring from oversea	☐	☐	☐	☐	☐
Ordering from enterprises	☐	☐	☐	☐	☐
Television, radio, newspaper, internet	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

14. In your experience, how would be possible to strengthen the communicate with farmers

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III. CAPABILITY OF THE AGENTS

15. How would you update/upgrade new knowledge/skill/career

	as mission	By individual
Collecting information in mass media as television, radio, internet, newspaper	☐	☐
Participating in the short training courses	☐	☐
Participating in the educational courses	☐	☐
Getting contact with business organization for new contracts	☐	☐
Getting the feedback of farmers and looking for solution from outside	☐	☐
	☐	☐
	☐	☐

16. How is the time table for the job of transferring innovation to farmers and other jobs

	%
Time for upgrading knowledge/skill	
Time for contacting with farmers	
Time for other mission	
Time for private operation	

17. How is your income

	%
From the job of transferring innovations to farmers	
From other jobs	

18. In your experience, how would be possible to increase the capability of the agents

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IV. EXAMINE THE EFFECT OF TRANSFORMING INNOVATIONS TO FARMERS

19. Do you see any effect of applying innovations in agriculture

Please give your ranking from 1 to 5 with: 1: very weak, 2: weak, 3: normal, 4: strong, 5: very strong

	1	2	3	4	5
Changing the way of agricultural production	☐	☐	☐	☐	☐
Positive contribute to the economic growth	☐	☐	☐	☐	☐
Positive effect on the natural environment	☐	☐	☐	☐	☐
Negative effect on the natural environment	☐	☐	☐	☐	☐
Changing the way of consumption (people care about purchasing safe products than other products)	☐	☐	☐	☐	☐
Changing the social-interest of innovative thinking	☐	☐	☐	☐	☐
People consider the role of local authorities and other association in supporting the innovative process	☐	☐	☐	☐	☐
More investment from state budget for agricultural R&D	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

20. In some projects, why don't they have the diffusion's effect

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21. In the following factors, would you please give your ranking from 1-5 to evaluate the influences of them on the process of transferring innovation to farmers

Please give your ranking from 1 to 5 with: 1: very weak, 2: weak, 3: normal, 4: strong, 5: very strong

	1	2	3	4	5
Market of outputs	☐	☐	☐	☐	☐
The role of technical staff	☐	☐	☐	☐	☐
The role of intermediate organizations	☐	☐	☐	☐	☐
The capability of farmers and their willingness	☐	☐	☐	☐	☐
The infrastructure condition as transportation, irrigation, electricity …	☐	☐	☐	☐	☐
The available and quality of inputs market	☐	☐	☐	☐	☐
Support of government as support policies in accelerating the application of innovations	☐	☐	☐	☐	☐
The factors of natural disaster, bad weather	☐	☐	☐	☐	☐
The changing in the international consumption	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

22. Would you give some experiences regarding the failure caused by unexpected factors? Do you see the recovery of farmers after the influences of such factors that follow to the experiences learned from the application of innovation previously.

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Thank you very much!

Erklärung

Hiermit erkläre ich, dass ich die vorliegende Dissertation selbstständig verfasst und keine anderen als die angegebenen Hilfsmittel genutzt habe. Alle wörtlich oder inhaltlich übernommenen Stellen habe ich als solche gekennzeichnet.

Ich versichere außerdem, dass ich die vorliegende Dissertation nur in diesem und keinem anderen Promotionsverfahren eingereicht habe und dass diesem Promotionsverfahren keine endgültig gescheiterten Promotionsverfahren vorausgegangen sind.

Pham, Quang Tri